

Basis of Findings

First Staff Draft Delta Plan

This packet contains the basis of findings for the following chapters of the First Staff Draft Delta Plan, released February 14, 2011:

Chapter 5 – Manage Water Resources

Chapter 6 – Restore Delta Ecosystem

Chapter 8 – Reduce Risks to People, Property, and State Interests in the Delta

Chapter 9 - Protect and Enhance the Unique Cultural, Recreational, Natural Resources, and Agricultural Values of the California Delta as an Evolving Place

Basis of Findings

Chapter 5 –Manage Water Resources

First Staff Draft Delta Plan

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Promote Statewide Water Conservation, Water Use Efficiency, and Sustainable Use of Water	5-11
Promote Options for New and Improved Water Conveyance, Storage Systems, and Operations of Both to Achieve the Coequal Goals	5-19
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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5 (p. 5-3):

California's total water supply is finite.

The Department of Water Resources' (DWR) Water Plan 2005 Update indicated that ninety-seven percent (97%) of the total volume of water that enters California annually is from rain and snow (precipitation). The remaining three percent (3%) flows into the state from Oregon, Nevada, or the Colorado River watershed. The DWR Progress on Incorporating Climate Change into Management of California's Water Resources (2006) indicated that the amount of precipitation entering the state between 1890 and 2000 was relatively constant at approximately 24 inches/year (as measured at 102 stations). The DWR Water Plan 2005 Update and Water Plan Update 2009 discussed that only one-third (1/3) of all the rain and snow in California can be used for human purposes or specified environmental purposes, such as instream flow requirements or sustainable wetlands. The remainder is removed from water supply through evaporation from snow and water body surfaces, evapotranspiration by vegetation and non-irrigated crops, and losses to unusable saline groundwater.

Of the water available for human uses and environmental water uses, less than sixty percent (60%) occurs in the area where ninety-six percent of the California population resides. In the year 2000 (a relatively "normal water year"), the amount of unimpaired runoff in the areas with 96% of the population was approximately 40 million acre-feet, or fifty-seven percent (57%) the total statewide runoff of 70 million acre-feet.

DWR's Water Plan 2009 Update indicated that for the year 2000 (the relatively "normal" water year), the consumptive water use for the area with 96% of the population was 43.5 million acre-feet, or sixty-nine percent (69%) of the total statewide consumptive water use (including environmental water uses) of 63.3 million acre-feet.

In summary, the total amount of precipitation has been constant for more than 100 years. Over 96% of the available water supplies from California are generated by this precipitation and appear to be finite. Of the available water supplies, less than 60% of the precipitation occurs in the portion of California where the majority of Californians live. These finite water supplies also do not appear to be adequate in normal years to fully meet the need for consumptive water use.

This finding is developed in support of Water Code section 85302:

(c) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:

- (1) Meeting the needs for reasonable and beneficial uses of water.*
- (2) Sustaining the economic vitality of the state.*
- (3) Improving water quality to protect human health and the environment.*

Additional Information:

California Department of Water Resources, 2005. *California Water Plan 2005 Update*.

California Department of Water Resources, 2009. *California Water Plan Update 2009*. December.

Western Regional Climate Center, 2011. *California Climate Tracker*. Web site (<http://www.wrcc.dri.edu/monitor/cal-mon/index.html>) accessed on February 21, 2011.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5, p. 5-3:

California's water infrastructure is increasingly vulnerable to external factors such as climate change.

The California Water Plan 2009 Update, published by the Department of Water Resources (DWR), indicated that climate change is already having a profound effect on California's water resources (Vol. 1, Ch. 4, p. 36):

- The average early spring snowpack in the Sierra Nevada decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage
- During the same period, sea level rose 7 inches along California's coast
- During the last 50 years, peak natural flows have increased on many of the state's rivers
- Many Southern California cities have experienced their lowest recorded annual precipitation twice within the past decade
- In the span of only two years, Los Angeles experienced both its driest and wettest years on record

DWR expects that the trends of the last century will likely intensify in this century. Expected impacts include the following (pp. 34-35):

- A reduction of snowpack will change water supply
- Changes in river flow will impact water supply, water quality, fisheries, and recreation activities
- Lower streamflows will tend to concentrate urban and agricultural runoff, creating more water quality problems
- Water supply reliability will be compromised
- Operation of the water system for urban, agricultural, and environmental water supply and for flood management will become increasingly difficult because of the decisions and trade-offs that must be made
- California's hydroelectric power generation may be less reliable, while higher air temperatures may increase energy consumption through increased use of air conditioning
- Increased flooding may cause more damage to the levee system
- Higher temperatures and changes in precipitation will lead to an increase in drought frequency
- Sea level rise will threaten the water system in the Delta, where existing levees were not designed or constructed to withstand higher water levels

This finding is developed in support of Water Code section 85302:

(c) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:

(1) *Meeting the needs for reasonable and beneficial uses of water.*

(2) *Sustaining the economic vitality of the state.*

(3) *Improving water quality to protect human health and the environment.*

Additional Information:

California Department of Water Resources, 2009. *California Water Plan 2009 Update*, Volume 1, Chapter 4. December.

Science Assessment:

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5, p. 5-3:

The Constitution of California requires that water be used for beneficial purposes, that water be used reasonably, and that no wasting of water shall occur.

Section 2, Article 10 of the California Constitution states the following:

It is hereby declared that because of the conditions prevailing in this State the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste of waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare.

The right to water or to the use or flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water.

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Additional Information:

California Constitution available online at <http://www.leginfo.ca.gov/const.html>. Website accessed on February 21, 2011.

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5 (p. 5-4):

California's water supply is provided by local, regional, state, and federal dams, reservoirs, and conveyance systems. However, improved regional water supply self-reliance is one of the major ways we can meet our coequal goals over the coming decades.

Section 10531 of the California Water Code states the following:

The reliability of water supplies can be significantly improved by diversifying water portfolios, taking advantage of local and regional opportunities, and considering a broad variety of water management strategies as described in the California Water Plan.

The Delta Vision Strategic Plan (2008) concluded that optimizing regional self-sufficiency, as well as conservation and efficiency improvements, are more likely to secure California's near-term water needs than state projects or facilities. The Strategic Plan states (p. 34):

Regional self-sufficiency is another important principal to guide the management of regional water supply portfolios. The more each region of California can rely on local supplies, the less stress is placed on the Delta ecosystem as a "switching yard" for huge quantities of water. Through its Integrated Regional Water Management Plan, California already recognizes that localized alternative supplies are preferable to moving stored water long distances.

Volume 2 of the California Water Plan 2009 Update outlines 27 resource management strategies, including 12 strategies related to increasing water supply, reducing water demand, and improving operational efficiency and transfers of water:

- Agricultural Water Use Efficiency (Ch. 2)
- Conjunctive Management and Groundwater Storage (Ch. 8)
- Conveyance – Delta (Ch. 4)
- Conveyance – Regional/Local (Ch. 5)
- Desalination (Ch. 9)
- Precipitation Enhancement (Ch. 10)
- Recycled Municipal Water (Ch. 11)
- Surface Storage – CALFED (Ch. 12)
- Surface Storage – Regional/Local (Ch. 13)
- System Reoperation (Ch. 6)
- Urban Water Use Efficiency (Ch. 3)
- Water Transfers (Ch. 7)

The most effective combination of these strategies will vary from region to region, depending on climate, projected growth, the existing water system, environmental and social conditions, and regional goals (Vol 2, Ch. 1, p. 6).

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Additional Information:

California Department of Water Resources, 2009. *California Water Plan 2009 Update*, Volume 2. December.

Delta Vision Blue Ribbon Task Force. 2008. *Delta Vision Strategic Plan*. October.

Science Assessment:

Analyses are pending but will address:

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5, p. 5-4:

Surface and groundwater supplies will only be reliable on a long-term basis if groundwater overdraft is eliminated.

The Legislative Analyst's Office (LAO) reports that in dry years, groundwater makes up 40 percent of the developed water supply (compared with 30 percent in years with average precipitation), and that at least 43 percent of Californians obtain some portion of their drinking water annually from groundwater sources. In some regions, the Department of Water Resources estimates that groundwater provides 60 percent or more of the supply during dry years (Bulletin 118 - Update 2003), and many small – to moderate-sized cities depend entirely on groundwater for their water supply.

In the 2003 Update of *Bulletin 118 – California's Groundwater*, the Department of Water Resources estimates that statewide overdraft of groundwater is between 1 million and 2 million acre feet per year. However, data published in the California Water Plan 2009 Update suggests that groundwater storage decreased by 56.6 million acre feet between 1998 and 2005, an average annual decrease of over 7 million acre feet.

Long-term management of groundwater as a reliable supply will require the development of plans for replenishment of groundwater aquifers in order to eliminate sustained overdraft.

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Additional Information:

California Legislative Analyst's Office, 2011. *Improving Management of the State's Groundwater Resources*. February 1, 2011.

California Department of Water Resources, 2009. *California Water Plan Update 2009*. December 2009.

California Department of Water Resources, 2003. *Bulletin 118 – California's Groundwater - Update 2003*. October 2003.

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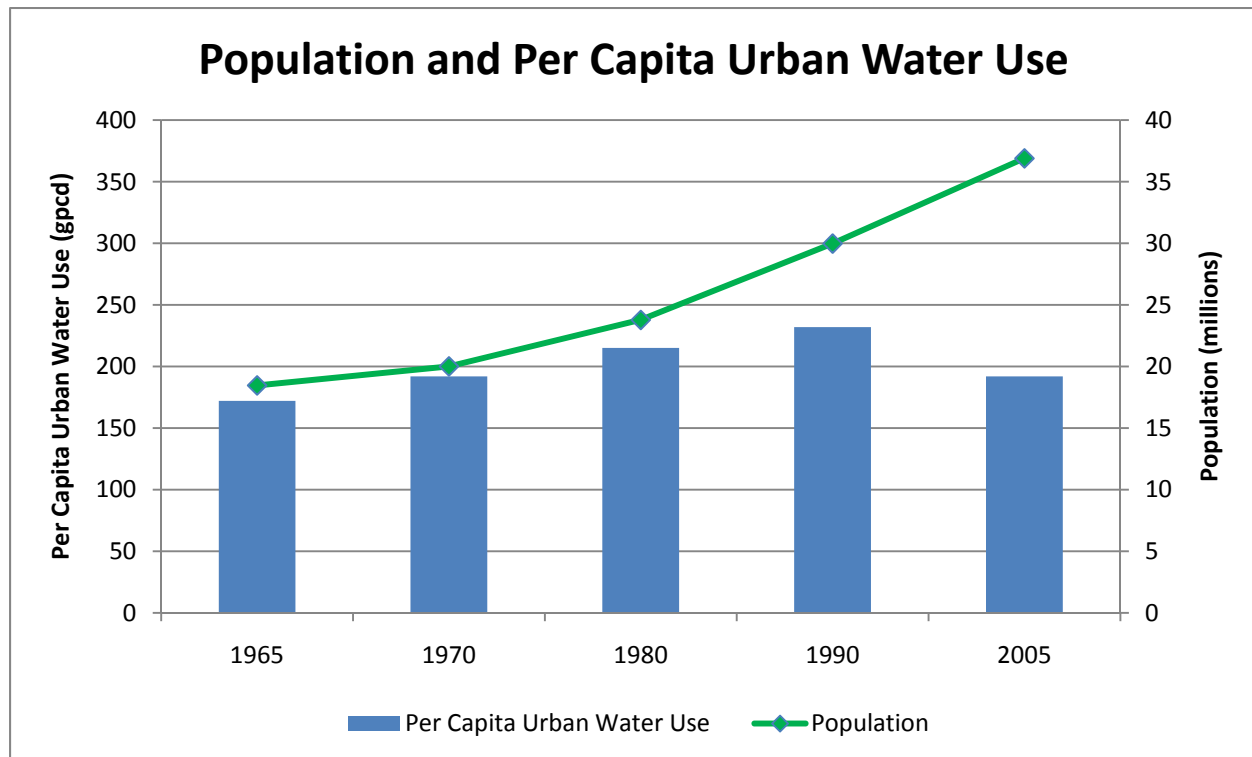
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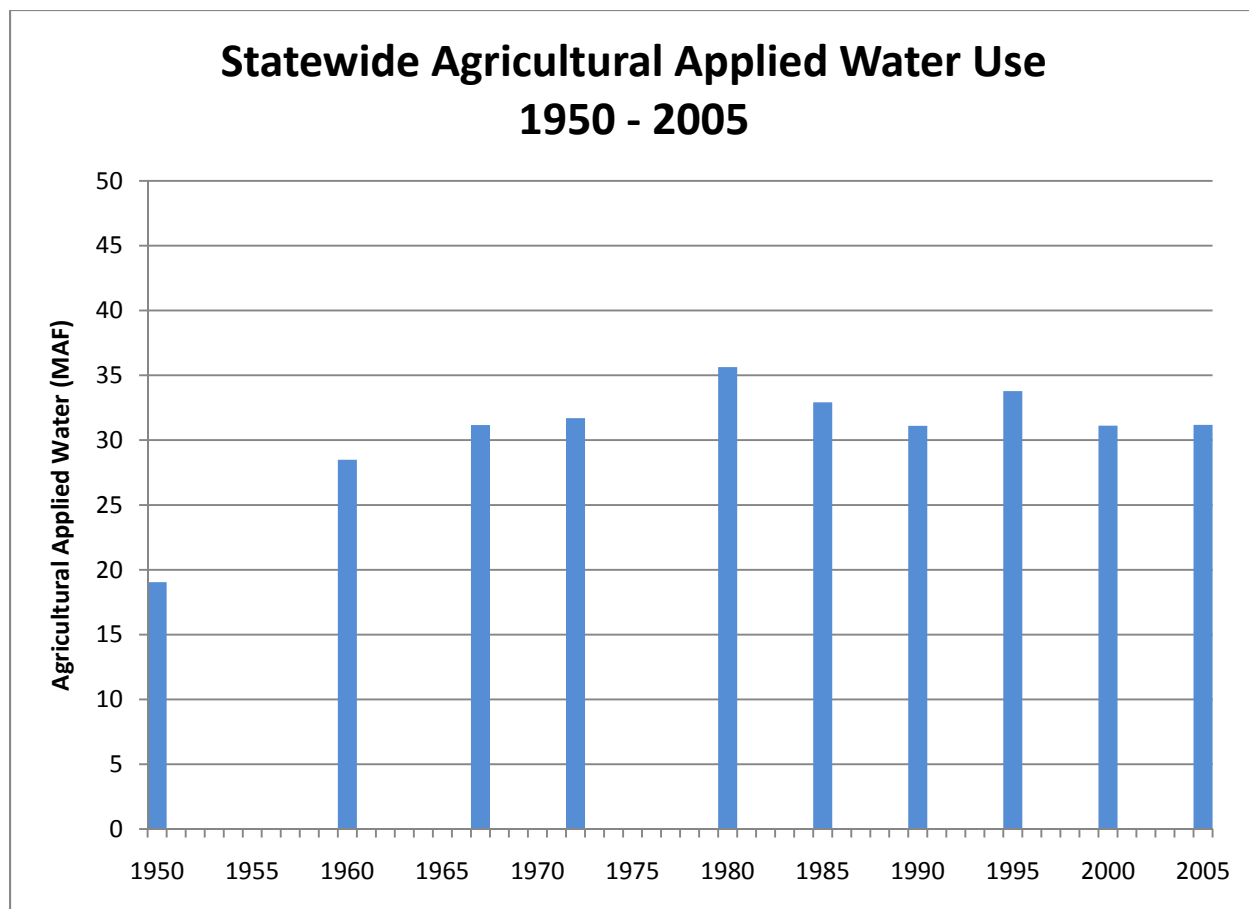
Urban residential water use has not declined for the past 40 years. Agricultural water use has continued to be at the same statewide level of approximately 31-36¹ MAF per year for many years. What remains of the available water supply is often called environmental water. With population growth and little change in water efficiency, California's demands will continue to increase.

The Department of Water Resources (DWR) periodically publishes *Bulletin 166 – Urban Water Use in California*, which includes estimates of regional and statewide per capita urban water use. Bulletin 166 has been published four times – in 1968, 1975, 1983, and 1994. DWR also produced estimates of per capita water use in the *20x2020 Water Conservation Plan*.



Between 1965 and 2005, the population of California doubled, and while per capita urban water use fell between 1990 and 2005, it still remains above the 1965 rate. The combination of population growth and increases in per capita water use, resulted in a doubling of statewide applied urban water use between 1967 and 2005 (from 4.5 to 9.0 MAF/yr). During the same period of time, agricultural water usage (applied) remained essentially constant, fluctuating from year to year between 31-36 MAF/yr (DWR and CDFA, 2008). These values could reflect changes in crop type and patterns, and not necessarily reductions in water use efficiency.

¹Values revised since publication of First Staff Draft Delta Plan



What remains of the available water supply is often called environmental water. With population growth and little change in water efficiency, California's demands will continue to increase.

This finding is developed in support of Water Code section 85303:

The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.

Additional Information:

California Department of Water Resources, 2010. *20x2020 Water Conservation Plan*. February 2010.

California Department of Water Resources, 2010. *20x2020 Water Conservation Plan*. February 2010.

California Department of Water Resources and California Department of Food and Agriculture, 2008. *Current Water Use Efficiency Policy and Programs and Estimate of Urban and Agricultural Water Use*.

California Department of Water Resources, 1994. *Bulletin 166-4: Urban Water Use in California*. August 1994.

California Department of Water Resources, 1983. *Bulletin 166-3: Urban Water Use in California*. October 1983.

California Department of Water Resources, 1975. *Bulletin 166-2: Urban Water Use in California*. October 1975.

California Department of Water Resources, 1968. *Bulletin 166-1: Municipal and Industrial Water Use*. August 1968.

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5 (p. 5-4):

Water conservation in all sectors can be significantly improved.

Regarding water conservation, the Legislature has declared the following (Water Code section 10608 (f)):

Improvements in technology and management practices offer the potential for increasing water efficiency in California over time, providing an essential water management tool to meet the need for water for urban, agricultural, and environmental uses.

The 20x2020 Water Conservation Plan prepared by the Department of Water Resources (DWR) further states that California can achieve at least a 20 percent reduction in per capita water use by 2020 (p. 31). The Water Conservation Plan outlines the following nine recommendations for improving water conservation (p. 31-32):

1. Establish a foundation for a statewide Conservation Strategy.
2. Reduce landscape irrigation demand.
3. Reduce waste.
4. Reinforce efficiency codes and related BMPs.
5. Provide financial incentives.
6. Implement a statewide conservation public information and outreach campaign.
7. Provide new or exercise existing enforcement mechanisms to facilitate water conservation.
8. Investigate potential flexible implementation measures.
9. Increase the use of recycled water and non-traditional sources of water.

This finding is developed in support of Water Code section 85303:

The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.

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California Department of Water Resources, 2010. *20x2020 Water Conservation Plan*. February, 2010.

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5, p. 5-5:

Reuse of water, recycling, groundwater management, stormwater capture, treatment and reuse of impaired waters, and sea water desalting are vital to improving the overall reliability of California's water supplies, but are not likely to be a major factor for several decades or more.

Based on data contained in the California Water Plan Update 2009, statewide annual applied water usage for urban and agricultural uses averaged 9 and 35 million acre feet per year (MAF/yr), respectively. In the California Water Plan Update 2005, the Department of Water Resources (DWR) estimated that 3.8 to 9.6 MAF/yr of additional water supplies could potentially be developed by the year 2030, as summarized below (Vol. 2, Ch.1, p. 5):

Water Source	Low Estimate (MAF/yr)	High Estimate (MAF/yr)
Precipitation Enhancement	0.3	0.4
Conveyance	0.3	0.4
Ocean & Brackish Desalination	0.3	0.5
Agricultural Water Use Efficiency (Net)	0.2	0.8
Surface Storage (CALFED)	0.1	1
Recycled Municipal Water	0.9	1.4
Conjunctive Management and Groundwater Storage	0.5	2
Urban Water Use Efficiency (Applied)	1.2	3.1
Total	3.8	9.6

The development of these additional water supplies, however, requires a minimum of 5 to 10 years to implement.

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The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.

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California Department of Water Resources, 2009. *California Water Plan Update 2009*. December 2009.

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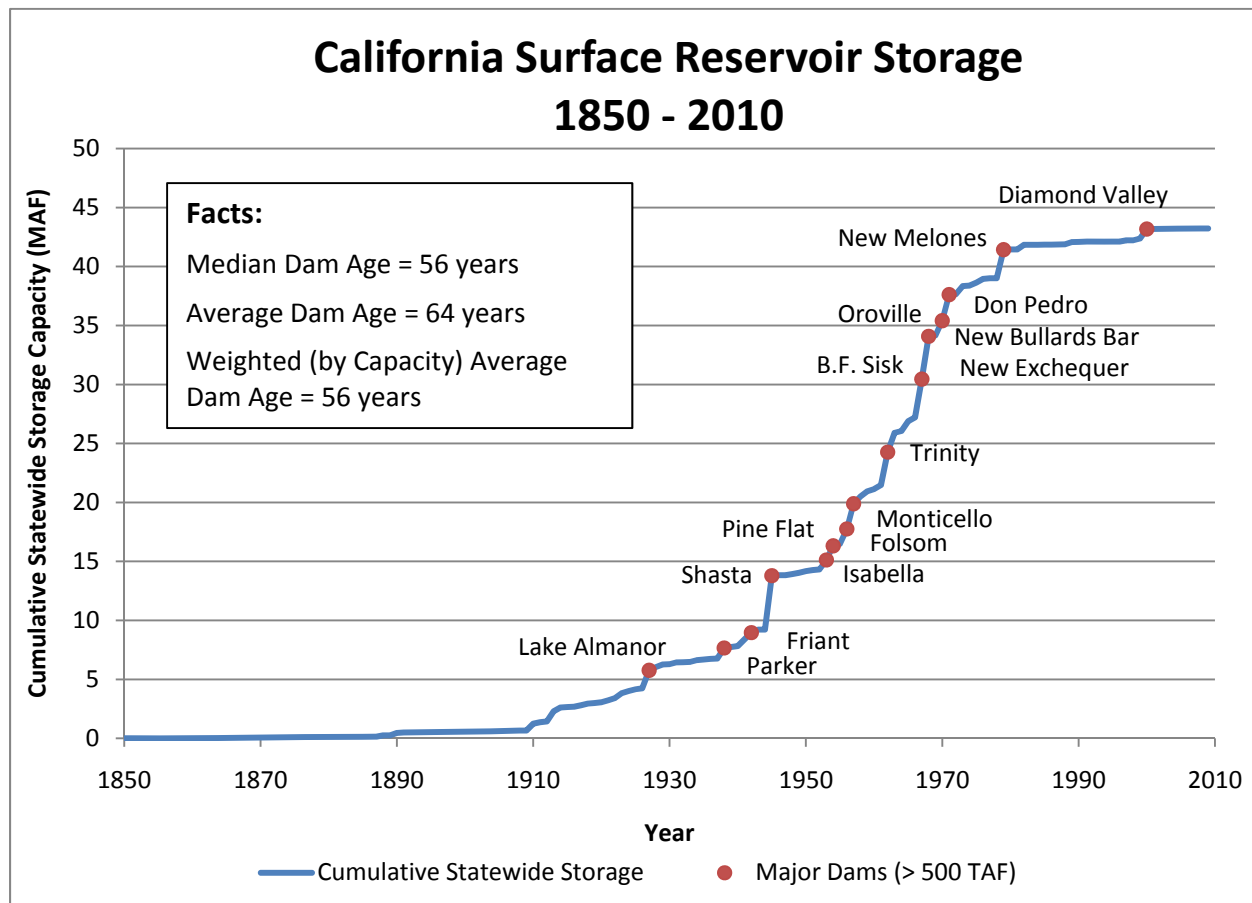
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Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5, p. 5-5:

Many of California's water supply facilities were initially planned and designed based on conditions in the late 1800s and early 1900s, and facilities may require major repairs due to age.

The Division of Safety of Dams, which is part of the Department of Water Resources, maintains data on all of the 1,400 dams under state and federal jurisdiction located in California. Based on the Division of Safety of Dams data, the average dam in California is 64 years and half of all dams in California are more than 56 years old. The lifetime of water supply facilities is specific to each structure. However, most structures and equipment require major replacement programs within 50 to 100 years of construction. For example, San Francisco's Hetch Hetchy Aqueduct (completed in 1934) and EBMUD's Mokelumne Aqueduct (completed in 1929) both required extensive repair and rehabilitation within 70 years of construction. Important elements of the State and Federal water projects, such as canals, aqueducts, and pumping plants, are approaching or exceeding 50 years of age and may require major repairs or replacement before 2100.



This finding is developed in support of Water Code section 85304:

The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

Additional Information:

California Department of Water Resources, Division of Safety of Dams, 2011. Listings of Dams under State and Federal Jurisdiction. Web site (<http://www.water.ca.gov/damsafety/damlisting/index.cfm>) accessed February 21, 2011.

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Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5 (p. 5-5):

State Water Project long-term average water delivery reliability has declined substantially in the past seven years.

The Department of Water Resources published *The State Water Project Delivery Reliability Report* in 2002, 2005, 2007 and 2009 to report on the current and future State Water Project (SWP) water supply conditions if no significant improvements were made to conveyance or storage facilities or operations as compared to current conditions at publication of the reports.

The SWP reliability for average long-term deliveries decreased over the past eight years, as shown below. During this same time period, the twenty-year water supply projections also decreased. A portion of the change in existing and projected water supply projections is related to implementation of additional environmental requirements that affect SWP operations. A portion of the change in projected water supplies is related to improved climate change projections over the past seven years.

**State Water Project Delta Average Table A Deliveries
(percentage of Maximum Table A^a Deliveries)**

	2002 Report	2005 Report	2007 Report	2009 Report
Conditions at Time of Report	72% (Year 2001)	68% (Year 2005)	63% (Year 2007)	60% (Year 2009)
Twenty-Year Projection at Time of Report	75% (Year 2021 ^b)	77% (Year 2025)	66-69% (Year 2027)	60% (Year 2029)

NOTE: ^a Table A contains the schedule of maximum amount of water each SWP contractor can receive annually.

^b Assuming a variable water demand based upon weather conditions.

This finding is developed in support of the objective stated in Water Code 85304.

The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

Additional Information:

Department of Water Resources, *The State Water Project Delivery Reliability Report in 2002*, Table 5.

Department of Water Resources, *The State Water Project Delivery Reliability Report in 2005*, Table 5-6.

Department of Water Resources, *The State Water Project Delivery Reliability Report in 2007*, Table 6-6 and 6-14.

Department of Water Resources, *The State Water Project Delivery Reliability Report in 2009*, Tables 6-5 and 6-14.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹⁰

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
General scientific reports and publications	Standard reports and analyses	Informal, internal/external	Medium	Available from source
Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
Anecdotal evidence	Personal observations and beliefs	Limited to none	Fast	Available from individuals and groups

¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. *Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems*. Marine and Freshwater Research 61: 821-828.

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5, p. 5-5:

Storage capacity must be increased and reservoir operations modified to improve water supply reliability.

The Department of Water Resources evaluated California's storage capacity and reservoir operations as part of the CALFED Surface Storage Investigations. Their 2010 Progress Report recognized California's needs and the similar conclusions of others (2010):

Management of California's water resources has reached a critical point. Our existing water resources infrastructure is strained to meet competing demands and existing objectives for water supply, environmental protection, water quality, flood protection, hydropower, and recreation. The strains on the system will only increase with a changing climate, and conflicts between competing interests will be even greater as ecosystems are further strained and supplies become less reliable.

The Delta Vision Blue Ribbon Task Force, CALFED, 2009 Comprehensive Water Package legislation, Delta Stewardship Council, and California Water Commission recognize the value and need for additional storage and improved conveyance in the context of our strained water system. The California Water Plan Update 2009 draws a similar conclusion.

The Delta Vision Strategic Plan (2008) recognized the need for expanded storage and conveyance in the context of meeting the coequal goals (pp 101-102):

The current conveyance and storage system places the coequal values in direct conflict because there is little flexibility in the timing or location of water flows through the Delta. The more choices there are in when and how to move water, the greater ability California will have to meet the flow needs of the Delta ecosystem and to achieve water supply reliability.

New conveyance alone is not enough. Storage must be increased and smarter operation of existing reservoirs implemented, to improve reliability for water users and reduce risk to the environment. If flow managers are to have the flexibility to move water through or around the Delta at appropriate times, there must be places for the water to be stored until it is needed. This applies both the upstream locations (from which water could be released to increase Delta inflow), and to locations downstream of export diversions (from which users could access it directly).

This finding is developed in support of Water Code section 85304:

The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

Additional Information:

California Department of Water Resources, 2010. *CALFED Surface Storage Investigations Progress Report Overview*. November.

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5 (p. 5-6):

Conveyance must be changed and re-operated to improve water supply reliability.

The Delta Vision Strategic Plan (2008) made the following statements and recommendations (pp. 101-102):

Achieving the coequal goals requires a strategy that expands conveyance and storage options statewide and builds facilities that move water through and around the Delta.

The current conveyance and storage system places the coequal values in direct conflict because there is little flexibility in the timing or location of water flows through the Delta. The more choices there are in when and how to move water, the greater ability California will have to meet the flow needs of the Delta ecosystem and to achieve water supply reliability.

Any new water conveyance must allow flexibility in the timing and quantities of diversions to shift away from periods with highest impacts on Delta and upstream ecology while still providing predictable and acceptable volumes of quality water for diverted uses.

The Bay Delta Conservation Plan (BDCP) is a process underway by state and federal resource agencies, conservation organizations, water agencies, local agencies, and others to protecting the Delta ecosystem while improving water supply reliability through several measures, including new and re-operated conveyance. The Highlights of the BDCP (2010) report explains:

A major piece of the conservation plan is a conveyance facility that would move water around or under, instead of through, the Delta. This facility would reduce through-Delta conveyance and thus minimize reverse flow conditions. As a result, this option would help restore the natural east-to-west flow of the Delta, reduce the entrainment of fish, and improve Delta habitat for multiple species.

This finding is developed in support of Water Code section 85304:

The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

Additional Information:

California Department of Water Resources. Highlights of the Bay Delta Conservation Plan. 2010.

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5, p. 5-6:

Local storage programs can improve capture and subsequent use of stormwater flows, and possibly dry weather runoff, to increase water supplies.

California Water Code section 10560 states the following:

(c) Most of California's current stormwater drainage systems are designed to capture and convey water away from people and property rather than capturing that water for beneficial uses.

(e) Stormwater, properly managed, can contribute significantly to local water supplies through onsite storage and reuse, or letting it percolate into the ground to recharge groundwater, thereby increasing available supplies of drinking water.

The Metropolitan Water District of Southern California (Metropolitan) published an update to its Integrated Water Resources Plan in 2010. Metropolitan identified the following opportunities in a working paper on stormwater and urban runoff (paraphrased from Technical Appendix, p. A.12-1):

- There is an annual average of more than 1 million acre-feet of stormwater runoff currently generated from urban areas in the valley floors alone within the Metropolitan service area
- There is more than 3.2 million acre-feet of available groundwater storage space within the Metropolitan service area (as of June 2006)
- Stormwater and dry-weather runoff can be captured and its use can be adapted to the physical/geological parameters specific to each local area
- Metropolitan has identified 34 stormwater projects and programs that are anticipated for completion between 2009 and 2020, which, if implemented, could collectively increase regional stormwater capture by 45,000-56,000 acre-feet/year (this amount will increase as more projects are developed within Metropolitan's service area)

Additional Information:

Metropolitan Water District of Southern California, 2010. *Integrated Water Resources Plan 2010 Update*, Technical Appendix A.12. October 12.

California Department of Water Resources, 2010. *California Water Plan Update 2010*, Volume 2, Chapter 8. December. p. 21.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5 (p. 5-6):

Many local, regional, state, and federal agencies and organizations collect water data, but use differing methodologies and levels of detail, which severely limits the usefulness of the information.

In the 20x2020 Water Conservation Plan, the Department of Water Resources (DWR) evaluated the strengths and limitations of various sources of urban water use data (p.12):

Data Source	Strength	Limitation
DWR – Public Water Systems Survey (PWSS)	<ul style="list-style-type: none"> Detailed water production, water delivery, population, and connections data. Categorized by market sectors (e.g., residential, commercial, industrial, etc.). Compiled into a central database. Conducted annually. 	<ul style="list-style-type: none"> Collected voluntarily, which impacts data completeness and accuracy. Recent data (2005-present) have not yet been compiled and validated, and are not available for use for this Plan.
DWR – Land and Water Use Program (LWUP)	<ul style="list-style-type: none"> An extension from PWSS database, with data validated and modified at a sub-county level and validated using professional judgment. Every area has a water use value. 	<ul style="list-style-type: none"> Only three (3) years of data are available (1998, 2000, and 2001).
California Urban Water Conservation Council (CUWCC)	<ul style="list-style-type: none"> Detailed water use data by demand sector/customer type Includes estimates of water saved through conservation Best Management Practices 	<ul style="list-style-type: none"> Only entered by Signatories of Memorandum of Understanding (approximately 225 of largest urban water suppliers in 2008) Values expressed in 2006 dollars.
CPUC	<ul style="list-style-type: none"> Recent urban water use data readily available. Mandatory so data set should be complete. 	<ul style="list-style-type: none"> Limited data points Only residential data available. Data for connections and water use only. Data was reported on annual basis, which limits the analysis for residential indoor/outdoor water use.
DPH	<ul style="list-style-type: none"> More complete database since the Safe Drinking Water Act requires water suppliers to report water use data annually. 	<ul style="list-style-type: none"> Not available electronically. Has not been compiled into a central database. Stored as hard copies in each DPH office across the state.
Urban Water Management Plans (UWMPs) prepared by Water Suppliers	<ul style="list-style-type: none"> Could provide more detail on water use because plans are prepared by individual water suppliers. Water suppliers serving more than 3,000 connections or more than 3,000 AFY are required by law to develop and submit UWMPs. Mandatory but compliance is not 100 percent. 	<ul style="list-style-type: none"> Developed only once every five years. Not compiled into a central database and therefore not available electronically. No data from small water suppliers that serve fewer than 3,000 connections or 3,000 AFY.

Ultimately, data from DWR's Public Water Systems Survey (PWSS) and Land and Water Use Program (LWUP) were used as the primary basis for developing baseline water use rates. However, even these data contain uncertainties and inaccuracies (p.13):

Because data submittal to DWR is voluntary, the completeness and accuracy of these data vary substantially between water suppliers. Some suppliers did not provide data for certain market sectors and/or certain years. Suppliers also used different methods in measuring water production and delivery. It is also evident that water suppliers had different understandings of specific data fields.

Most suppliers did not provide data on recycled water. If recycled water data were provided, they were removed from the demand data used to calculate per capita use. This plan encourages greater use of recycled water by crediting the substitution of recycled water for potable water as a reduction in potable per capita water use.

Water production of private water suppliers (e.g., residents with private water wells) is not captured in the PWSS database and was therefore also excluded from this analysis.

This finding is developed in support of Water Code section 85211:

The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in... the reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.

Additional Information:

California Department of Water Resources, 2010. *20x2020 Water Conservation Plan*. February.

California Department of Water Resources, 2009. *California Water Plan Update 2009*, Volume 1, Chapter 2, pages 7-8. December.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹⁴

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. *Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems*. Marine and Freshwater Research 61: 821-828.

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 5 (p. 5-6):

To better understand and track the ways water is used in the urban, agricultural and environmental sectors, a rigorous, mandatory statewide data collection and analysis program is needed.

The 20x2020 Water Conservation Plan, published by the Department of Water Resources in 2010, strongly recommends mandated (as opposed to voluntary) data collection and the establishment of a statewide urban water use database (pp. 34-35):

California currently lacks a consistent method of collecting water data from local water suppliers. Water data is collected by different state agencies based on their individual program needs, which leads to overlaps and gaps between the databases. This has been an obstacle in the data analysis and per capita water use calculations during the development of the baseline and target numbers. It is recommended that California mandate submittal of water use and conservation data. Submittal of the data should be coordinated among state agencies to reduce reporting burdens on local water suppliers.

A uniform streamlined data collection process would have multiple advantages: the reporting burden on local agencies would be reduced, data reviews related to state action such as grant disbursement would be expedited, state agencies would have more timely access to water use data, the quality and accuracy of the data would improve, better and more complete data would facilitate better water management; and data management costs would be reduced over time.

Regarding other data relevant to water use, the California Water Plan Update 2009 also notes that the following categories of information are not available or are very expensive to compile (Vol. 1, Ch. 6, pp. 7-8):

- Statewide land use – native vegetation, urban footprints, nonirrigated and irrigated agriculture
- Groundwater – total natural recharge, subsurface inflow and outflow, recharge of applied water, extractions, groundwater levels, pumping-induced land subsidence, and water quality
- Surface water – natural and incidental runoff, local diversions, return flows, total streamflows, conveyance seepage and evaporation, runoff to salt sinks, and water quality
- Consumptive use – evaporation and evapotranspiration from native vegetation, wetlands, urban runoff, and nonirrigated agricultural production
- Soil moisture characteristics – water saturation, porosities, and field capacities
- Environmental/biological data – species monitoring and their habitat and water requirements
- Land elevations and channel bathymetry
- Current and future price of water by supply source

This finding is developed in support of Water Code section 85211:

The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in... the reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.

Additional Information:

California Department of Water Resources, 2010. *20x2020 Water Conservation Plan*. February.

California Department of Water Resources, 2009. *California Water Plan Update 2009*, Volume 1, Chapter 2, pages 7-8. December.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹⁵

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Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

Basis of Findings

Chapter 6 –Restore Delta Ecosystem

First Staff Draft Delta Plan

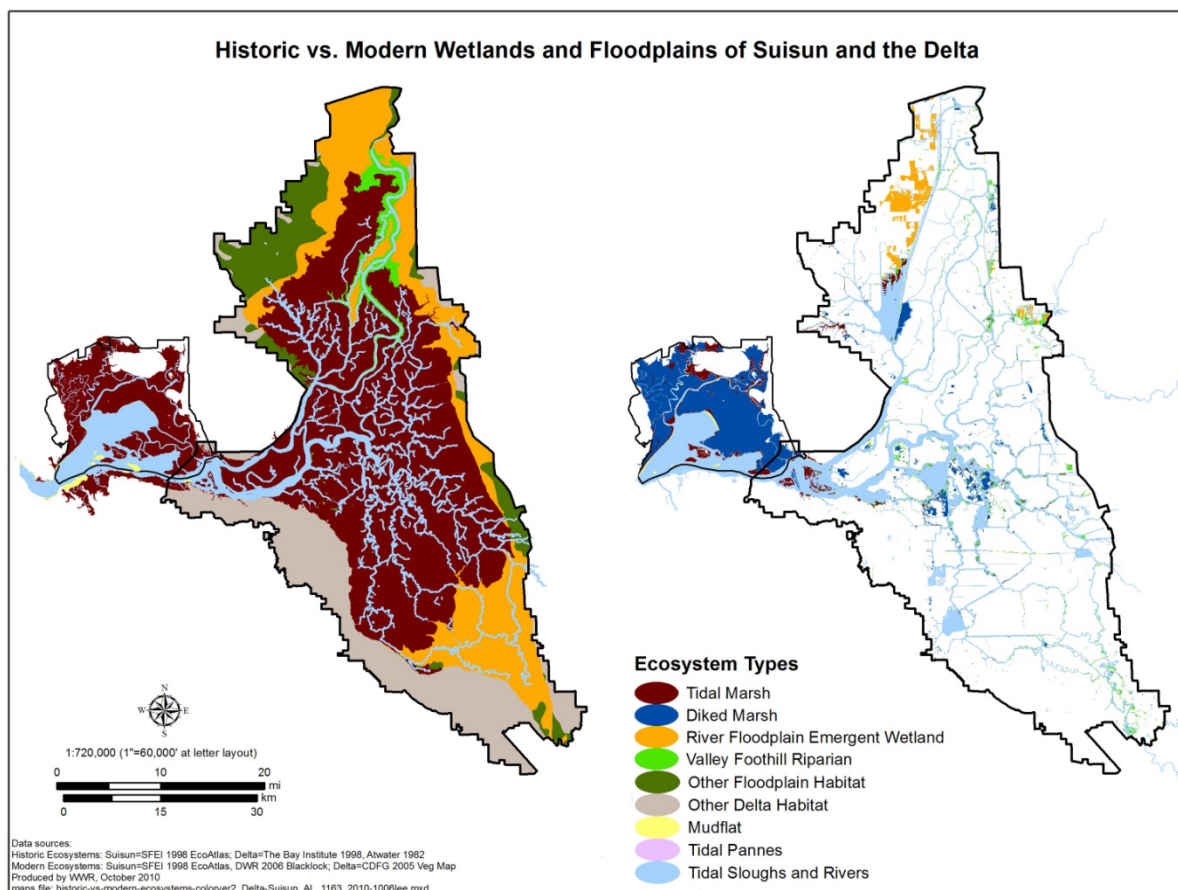
Restore or Protect Habitat	6-1
Improve Water Quality	6-15
Promote Viable Populations of Native Resident and Migratory Species	6-19
Establish Migratory Corridors.....	6-21
Reduce Threats and Stresses	6-23
Provide a More Natural Flow Regime	6-29

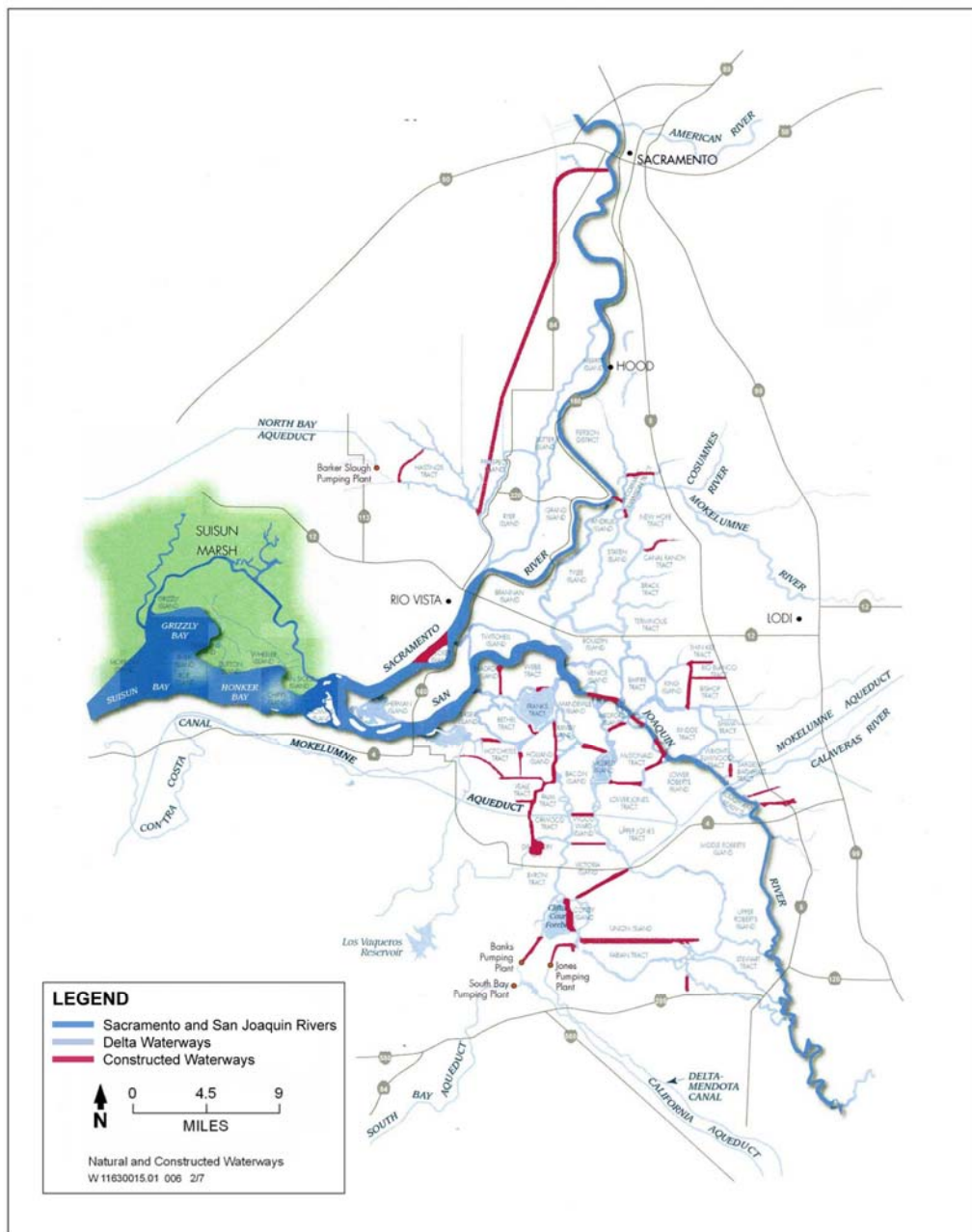
BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-3:

Habitat Extent and Complexity Have Been Substantially Eliminated in The Delta and Suisun Marsh.

The Delta is now relatively uniform and largely lacking in natural habitats, and Suisun Marsh, while mainly seasonal managed wetlands, is lacking natural habitat diversity. Levees have severed tidal creek systems, while meander cutoffs and channel cuts have simplified channel structure and complexity and made the Delta waterways highly connected (DWR 1995 [Delta Atlas]). Whole tidal marsh systems and floodplains at the Delta margins have been removed and most of Suisun's tidal marshes are now diked and managed predominantly for waterfowl hunting, affecting their functioning as native resident fish and migratory bird habitats and migratory corridors. The complex geometry of the original Delta and Suisun ecosystems, in combination with variable flow and transport processes, promoted native population resilience by providing extensive and structurally diverse habitats that allowed full expression of evolved life history strategies.





This finding is developed in support of the objective stated in the following sections of the Water Code.

85022(d)(5). Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.

85302(c)(3). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Diverse and biologically appropriate habitats and ecosystem processes.

85302(e)(1). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Restore large areas of interconnected habitats within the Delta and its watershed by 2100.

85302(e)(6). *The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.*

Additional Information:

Moyle, P.B., W.A. Bennett, W.E. Fleenor, and J.R. Lund. 2010. Habitat variability and complexity in the Upper San Francisco Estuary. Delta Solutions, Center for Watershed Sciences, University of California at Davis.

<http://deltasolutions.ucdavis.edu>

Department of Water Resources. 1995. Delta Atlas. Sacramento, CA

The Bay Institute. 1998. From the Sierra-to-the-Sea: the Ecological History of the San Francisco Bay-Delta Watershed. Novato, California.

Atwater, B. F. 1982. Geologic Maps of the Sacramento-San Joaquin Delta, California. U.S. Geological Survey MF-1401, Menlo Park, CA.

San Francisco Estuary Institute. 1998. EcoAtlas Baylands Maps. Oakland, CA. <http://www.sfei.org/ecoaatl>

Department of Fish and Game. 2005. Vegetation Map of the Delta.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-3:

The Delta Ecosystem is Irreversibly Changed.

Through a variety of human actions that have substantially affected the Delta ecosystem, restoration to historical Delta conditions is not possible. In addition, recent evidence related to the Pelagic Organism Decline suggests that the ecosystem has undergone a regime shift (Baxter et al. 2010).

“Some change is simply irreversible because key attributes of the original regime have been irretrievably lost. These features of regime shift have many important implications for ecosystem management and restoration such as surprising collapses, slower than expected recovery, or overall unexpected outcomes of recovery efforts. Consequently, adaptive management approaches require flexibility with a strong learning (science) component.”

Protection and restoration of the Delta ecosystem is required by law; however, the expectations for success must be moderated by the reality of restoration. Large scale restoration is very difficult, and there will be limitations to restoration in the context of current and future stressors. This does not suggest that restoration will be ineffective; instead realistic expectations must be identified for restoration and desired outcomes.

Human activity in the Delta and the Delta watershed has substantially reduced the physical extent of connected habitat in Delta relative to historical levels and disrupted important ecosystem processes. Some of these changes can be reversed (e.g., by creating or restoring physical habitat), while others cannot. A return to conditions that more closely mimic the historical ecosystem, even at a reduced scale, is not possible for several reasons, including the presence of legacy stressors in the system, establishment of exotic species, the possibility of a regime shift, and climate change.

The Independent Science Board identified several categories of stressors on the Delta ecosystem in its recent evaluation (ISB 2011). Among these were “legacy stressors” that are the product of past actions in the Delta watershed that cannot be undone. These stressors will continue to influence the Delta ecosystem and limit restoration outcomes. New stressors that further affect the ecosystem are inevitable. As a consequence, the Delta ecosystem may be on the verge of shifting (or already shifted) to a new regime. That is, a new, stable ecological state that may hinder or preclude a return to the previous state. In a recent synthesis, Baxter et al. (2010) hypothesize that the recent Pelagic Organism Decline may be the result of a regime shift Delta ecosystem.

This finding is developed in support of the objective stated in the following sections of the Water Code.

85022(d)(5). Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.

85302(c)(3). *The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Diverse and biologically appropriate habitats and ecosystem processes.*

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85302(e)(6). *The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.*

Additional Information:

Baxter, R., Breuer, R. Brown, L., Conrad, L., Feyrer, F., Fong, S., Gehrts, K., Grimaldo, L., Herbold, B., Hrodey, P., Mueller-Solger, A., Sommer, T., Souza, K. Interagency Ecological Program, 2010. Pelagic Organism Decline work plan and synthesis of results.

Independent Science Board. 2011. Addressing Multiple Stressors and Multiple Goals in the Delta Plan. Memo to the Delta Stewardship Council. January 26, 2011.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

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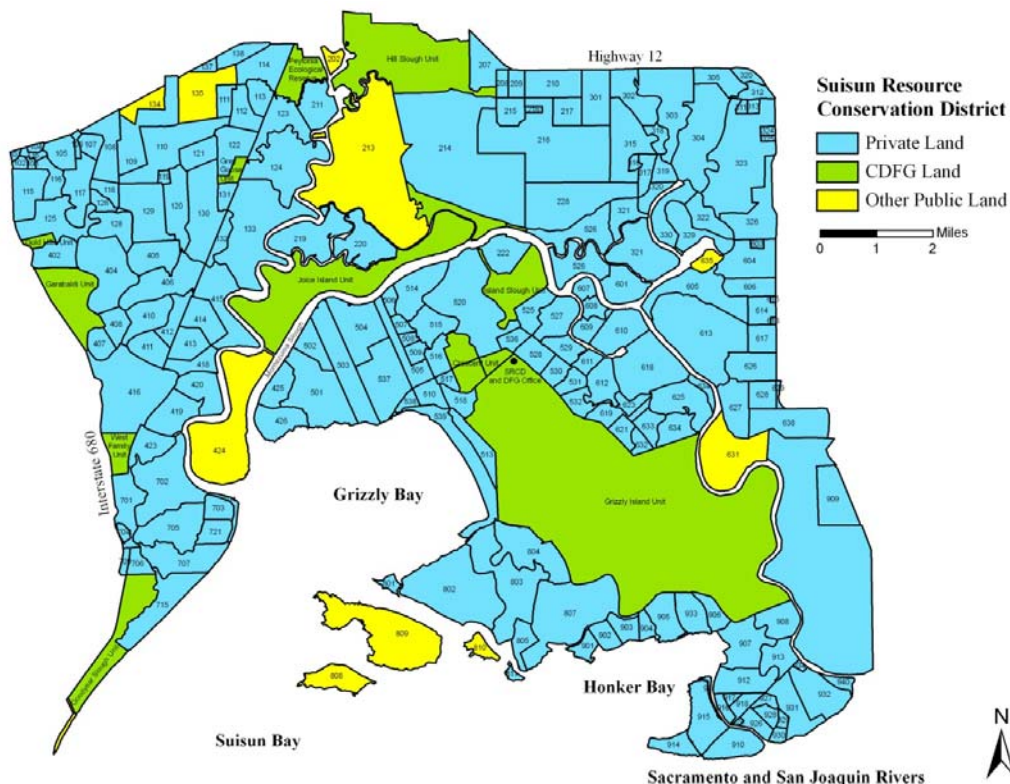
BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-4:

Natural Ecosystems Seldom Conform with Political Boundaries or Land Ownership Patterns

Ecosystem restoration for conservation of native species requires consideration of whole-landscape attributes and connectivity at natural spatial and temporal scales, regardless of political or ownership boundaries. Doing so promotes native species resilience by allowing full expression of population life history strategies for survival, growth, and reproduction. Properly scaled and located restoration actions would leverage historical landscape features, minimize the need for costly flood control levees, and create persistent overlaps between aquatic physical/chemical attributes and landscape morphologies that provide access, forage, cover, and physiological adaptation opportunities during all life-history phases. Land acquisition strategies for restoration of native species should consider ecological relationships and connectivity that leverage historical landscape features and consider whole landscape functioning and at ecologically relevant scales.

Suisun Marsh illustrates the finding well. Approximately 160 private duck clubs exist alongside lands owned by the Department of Fish and Game, Suisun Resource Conservation District, and the Solano Land Trust. Restoration at the landscape scale in Suisun would cross these ownership boundaries.



This finding is developed in support of the objective stated in the following sections of the Water Code.

85022(d)(5). Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.

85302(c)(3). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Diverse and biologically appropriate habitats and ecosystem processes.

85302(e)(1). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Restore large areas of interconnected habitats within the Delta and its watershed by 2100.

85302(e)(6). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.

Additional Information:

Peterson, MS. 2003. A conceptual view of environment-habitat-production linkages in tidal river estuaries. Reviews in Fisheries Science 11:291-313.

Simenstad, C.A. 2004.

Suisun Resource Conservation District. 2006. Ownership Map.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.³

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
General scientific reports and publications	Standard reports and analyses	Informal, internal/external	Medium	Available from source
Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
Anecdotal evidence	Personal observations and beliefs	Limited to none	Fast	Available from individuals and groups
Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-4:

The Processes for Obtaining Project-Specific Permitting and Authorization Are Not Well Coordinated, which Could Delay Progress on Ecosystem Restoration

Implementation of ecosystem restoration projects frequently requires the receipt of multiple permits related to water quality, endangered species, streambed alteration, land use, and other issues. Environmental review or permits are required at the federal, state, and local levels.

At the federal level, compliance with the National Environmental Policy Act may require an Environmental Impact Statement or Environmental Assessment. Federal authorizations can include:

- Clean Water Act dredge and fill permit (Section 404)
- Clean Water Act Water Quality Certification (Section 401)
- Clean Water Act National Pollution Discharge Elimination System permit (Section 402)
- Consultations with U.S. Fish and Wildlife Service and National Marine Fisheries Service under the federal Endangered Species Act, which can result in a Section 7 Take permit
- Consultation under the National Historic Preservation Act
- Permits from the U.S. Coast Guard if navigation concerns arise

At the State level, compliance with the California Environmental Quality Act may require an Environmental Impact Report, Mitigated Negative Declaration, or Negative Declaration. State authorizations can include:

- Lake and Streambed Alteration Agreement (Fish and Game Code 1600)
- Waste Discharge Requirements (Porter-Cologne Water Quality Act)
- Suisun Marsh Permit (Suisun Marsh Protection Act)
- State Lands Lease Amendment (Sovereign title interest or public trust easement)
- California Endangered Species Act coordination that can result in Section 2080.1 permit
- In the future, a Delta Stewardship Council Consistency Determination (Delta Reform Act)

Local government permits will also be required for non-state and non-federal project sponsors. Exact local government requirements vary but may include grading permits, conditional use permits, and surface mining permits. Coordination currently is limited to the Corps of Engineers hosting monthly Interagency Regulatory meetings where project sponsors can bring projects at early stages. Some coordination also takes place internally within agencies but no formal coordination mechanisms exist.

Restoration projects will in large part share a common suite of concerns and involve a common suite of design elements. This myriad list of regulatory compliance requirements, applied repetitively to each restoration project, will be painstaking, perpetuate controversy, delay resource benefits, and expend precious ecosystem recovery dollars unnecessarily.

This finding is developed in support of the objective stated in the following sections of the Water Code.

85022(d)(5). *Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.*

85302(c)(3). *The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Diverse and biologically appropriate habitats and ecosystem processes.*

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Additional Information:

Federal: Clean Water Act, Endangered Species Act, Migratory Bird Treaty Act, Fish and Wildlife Coordination Act, National Environmental Policy Act, National Historic Preservation Act

State: Porter-Cologne Water Quality Act, Suisun Marsh Protection Act, Fish and Game Code, California Endangered Species Act, Natural Communities Conservation and Planning Act, Delta Reform Act

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

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Additional Information:

Federal: Clean Water Act, Endangered Species Act, Migratory Bird Treaty Act, Fish and Wildlife Coordination Act, National Environmental Policy Act, National Historic Preservation Act

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Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

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Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-4:

Even with Substantial Restoration Efforts, Some Native Species May Not Survive.

This finding acknowledges the reality of the current condition of the Delta Ecosystem and the prospect of continued change resulting from factors for which humans have little control. The expected outcomes of restoration of the Delta ecosystem (which is required as part the coequal goals) need to be realistic. This finding is intended to clarify expectations and focus restoration efforts; it does not suggest that restoration is unnecessary.

A variety of drivers and stressors impinge on the survival of native species in the Delta, and the outlook for viability and long-term survival of some desired native aquatic species will depend in part on the manner in which water is managed in the Delta in the future and how the Delta is influenced by climate change. In 2008, 39 experts on Delta fish and ecology were asked to estimate the probability of viable populations of key fish species in the Delta under four water export management alternatives, including estimates for the future in anticipation of climate change (Bennett et al. 2008). Despite the inevitable uncertainties, the survey showed consensus of scientific opinion on several key points that are relevant for forward-looking policymaking in the Delta. They indicated that the details of how export strategies are implemented can greatly improve the prospects for fish and that the prospects for many desirable Delta fish will diminish with climate change, under all water export alternatives, including ending exports. They also suggested that delta smelt face significant risks of extinction no matter which export alternative is chosen, but particularly with continued in-Delta pumping of water exports.

In another study, Feyrer et al. (2010) examined how changes in outflow in the San Francisco Estuary due to future development and climate change might affect habitat suitability for delta smelt. Their modeling of future scenarios suggested that the future of delta smelt is particularly grave. Although there is considerable uncertainty about such projections, the fact that all of the model outputs suggested a deterioration of habitat represents a major issue for delta smelt because of its vulnerability to extinction.

This finding is developed in support of Water Code sections:

85022(d)(5). Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.

85302(e)(1). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Restore large areas of interconnected habitats within the Delta and its watershed by 2100.

85302(c)(3). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Diverse and biologically appropriate habitats and ecosystem processes.

85302(e)(6). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Restore habitat necessary to avoid a net loss

of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.

Additional Information:

Bennett, W.A., E. Hanak, J.R. Lund, and P.B. Moyle. 2008. Expert Survey on the Viability of Delta Fish Populations, Technical Appendix E *in* Lund et.al. (2008), Comparing Futures for the Sacramento–San Joaquin Delta. Copyright © 2008 by Public Policy Institute of California. All rights reserved San Francisco, CA.

Feyrer, F., K. Newman, M. Nobriga and T. Sommer. 2010. Modeling the effects of future outflow on the abiotic habitat of an imperiled estuarine fish. *Estuaries and Coasts*. DOI: 4867 10.1007/s12237-010-9343-9.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using ‘best available science’: a policy conundrum for the management of aquatic ecosystems</i> . <i>Marine and Freshwater Research</i> 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-4:

Restoring a Healthy Ecosystem May Require Developing a More Natural Salinity Regime in Parts of the Delta.

Estuaries are generally recognized as places where fresh water from the land mixes with salt water from the coastal ocean within a semi-confined area. Variability in the physical and chemical attributes of the water across time and space driven by the mixing of salt water and fresh water and the complexity and diversity of natural habitats are the hallmarks of estuaries. This variability and complexity reflects seaward gradients in salinity and other water quality parameters, the diversity and geographic distribution of natural habitats, and the presence of floodplain habitats along the rivers entering the estuary. The San Francisco Bay-Delta estuary now lacks many of the critical attributes, and modern management activities reduce the exact variability essential to high estuarine productivity in order to meet salinity needs for in-Delta and exported uses.

Today's Delta, in most all respects, is completely unlike its historical condition and unlike most any natural estuary around the world. Humans have completely altered the geometry of the estuary through diking of wetlands and floodplains, connecting most all waterways and converting them into levee-bounded navigation and conveyance canals, changing flow regimes to move Sacramento and San Joaquin river water south to the South Delta export pumps, and regulating Delta salinity to be as uniform and low as possible.

Restoration of estuarine ecosystem services requires re-establishing, at multiple scales, physical-chemical variability in time and space, as well as habitat complexity and diversity as Moyle et al. (2010) state:

"The San Francisco Estuary (the Estuary), especially the Sacramento–San Joaquin Delta (the Delta), must become more variable in space and time to support desirable aquatic species, such as delta smelt (Hypomesus transpacificus) and striped bass (Morone saxatilis) (Lund and others 2007; Moyle and Bennett 2008). Changes in water management, a more intricate network of channel geometry, and improved quantity and quality of inflows from the San Joaquin and Sacramento rivers are key actions needed to shift the Estuary into a more desirable state."

Restoration of a more natural salinity regime will promote development of other physical-chemical characteristics important for a healthy ecosystem such as water residence times, temperature, suspended sediment, and organism composition. Salinity variability is a convenient indicator of estuarine variability because gradients in other important physical–chemical characteristics often (but not always) track salinity and because salinity is relatively easy to measure and physiologically important to most organisms, serving as a major determinant of their distribution in the estuary.

This finding is developed in support of the following sections of the Water Code.

85022(d)(6). Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

85302(e)(5). *The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.*

Additional Information:

Lund J., Hanak E., Fleenor W., Bennett W., Howitt, R., Mount J., and Moyle P. 2007. *Envisioning futures for the Sacramento–San Joaquin Delta*. San Francisco: Public Policy Institute of California.

Moyle, P. B., W.A. Bennett, C. Dahm, J.R. Durand, C. Enright, W.E. Fleenor, W. Kimmerer, and J.R. Lund. 2010. *Changing ecosystems: a brief ecological history of the Delta*. Center for Watershed Sciences, University of California, Davis.

Moyle, P. B., W.A. Bennett, W.E. Fleenor, and J.R. Lund. 2010. *Habitat Variability and Complexity in the Upper San Francisco Estuary*. *San Francisco Estuary and Watershed Science* 8 (3): 1-24.

Moyle, P.B. and W.A. Bennett. 2008. *The future of the Delta ecosystem and its fish*. Technical appendix D. *In*: Lund, J., H. Hanak, W. Fleenor, R. Howitt, J. Mount, and P. Moyle. *Comparing futures for the Sacramento–San Joaquin Delta*. San Francisco (CA): Public Policy Institute of California.

The Bay Institute. 1998. *From the Sierra-to-the-Sea: the Ecological History of the San Francisco Bay-Delta Watershed*. Novato, California.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using ‘best available science’: a policy conundrum for the management of aquatic ecosystems</i> . <i>Marine and Freshwater Research</i> 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-5:

Contaminants Discharged from Municipal, Industrial, and Agricultural Sources Directly or Indirectly Into the Delta Have Affected Native Species by Altering Food Webs, Reducing Food Web Productivity, and Producing Toxicity.

Contaminants have been identified as an important stressor and driver of declines in ecosystem function in the Delta and Suisun Marsh. An unknown number of chemicals are introduced into the Delta from a variety of sources, including point sources such as effluents from municipal and industrial wastewater treatment plants, as well as urban, agricultural, and industrial nonpoint sources. The fate of contaminants in the estuarine ecosystem is complex, depending on interactions among transport, mixing, and residence times. Contaminant effects are generally species-specific. Pesticides and heavy metals are more likely to directly affect lower trophic levels, with potential negative effects on species composition and food web dynamics. At higher trophic levels, toxic effects are less likely to cause direct mortality, but sublethal toxicity may reduce fitness through impaired growth, reproduction, or behavior, or by increasing the organism's susceptibility to disease.

Compared to other estuaries, phytoplankton primary productivity in the San Francisco estuary is low and has experienced a long-term decline as Baxter et al. (2010) note:

"Compared to other estuaries, phytoplankton primary productivity in the San Francisco estuary is low and has experienced a long-term decline. The long-term decline has been linked to grazing by invasive clams and to shifts in nutrient ratios and concentrations, especially increasing ammonium concentrations. It has led to a decline in overall food availability for pelagic fishes. In addition, there have been substantial changes in phytoplankton and zooplankton community composition which led to changes in food quality..."

Shifts in community composition at the base of the food web may be as important as declines in overall productivity, or perhaps even more important. The current composition may favor non-native over native consumers..."

The long-term decline in primary productivity has been linked to grazing by invasive clams and to shifts in nutrient ratios and concentrations, especially increasing ammonium concentrations, and has led to a decline in overall food availability for pelagic fishes. In addition, there have been substantial changes in species composition in the phytoplankton and zooplankton communities which have led to changes in food quality. Low and declining primary productivity in the estuary is likely a principal cause for the long-term pattern of relatively low and declining biomass of pelagic fishes in the estuary. However, it is not likely the sole driver behind the recent POD decline because phytoplankton and zooplankton declines preceded the POD, current clam abundance and biomass is not unprecedented, and new research shows that many zooplankton species currently present in the estuary are omnivorous and can derive energy through detrital pathways rather than consumption of phytoplankton.

This finding is developed in support of the following sections of the Water Code:

85022(d)(6). Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

85302(e)(5). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.

Additional Information:

Baxter, R., R.Breuer, L.Brown, L.Conrad, F. Feyrer, S., Fong, K. Gehrts, L. Grimaldo, B. Herbold, P. Hrodey, A. Mueller-Solger, T. Sommer, and K. Souza. 2010. Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results.

Glibert, P.M. 2010. Long-term changes in nutrient loading and stoichiometry and their relationships with changes in the food web and dominant pelagic fish species in the San Francisco Estuary, California. *Reviews in Fisheries Science* 18:211–232.

Jassby, A. D., J. E. Cloern, and B. E. Cole. 2002. Annual primary production: patterns and mechanisms of change in a nutrient-rich tidal ecosystem. *Limnology and Oceanography* 47: 698–712.

Werner, I., L. Deanovic, D. Markiewicz, M. Stillway, N. Offer, R. Connon, and S. Brander, 2008. Final Report. Pelagic Organism Decline (POD): Acute and Chronic Invertebrate and Fish Toxicity Testing in the Sacramento-San Joaquin Delta 2006-2007. UC Davis – Aquatic Toxicology Laboratory, Davis, CA.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-5:

Flood Management Above the Delta and at the Delta Margins Has Substantially Reduced the Habitat for Native Species That Use Floodplains.

Most Floodplains in the Central Valley Lack Connectivity with the Rivers to the Detriment of the Ecosystem.

Levee construction along the major tributaries to the Delta channelized river corridors and disconnected the rivers from the adjacent low-lying areas that once served as floodplains. In addition the effects of the levees, management of flood waters made possible by the dams not only allowed conversion of floodplain habitats to other uses, but reduced frequency, depth, and duration of inundation on remaining floodplains.

In a recent review on habitat variability and complexity in the upper San Francisco estuary, Moyle et al. (2010) characterized the importance of floodplains to native species as follows:

“Most floodplains in the Central Valley have been isolated from their rivers by levees. Recent studies demonstrate that floodplains are good for desirable fishes, as well as for waterfowl of all types (Opperman et al. 2009). Many fishes rear opportunistically on floodplains (Moyle et al. 2007) and juvenile salmon grow faster and become larger (Sommer et al. 2007, Jeffres et al. 2008). Splittail require such habitat for spawning (Moyle et al. 2007). Floodplains also can generate nutrients for downstream areas (Jassby and Cloern 2000). Increasing the amount of regularly flooded seasonal habitat, with large expanses flooded during wetter years, will have large benefits to fishes, especially if the physical structure of flooded areas is taken into account and perhaps modified (Feyrer et al. 2006). Flooding large expanses of habitat during winter and spring on an irregular basis (frequencies of every 2-7 years) can produce large year classes of some species, to help carry their populations through dry periods. This can be done by improving management of the Yolo Bypass for fish, by increasing floodplain areas along other rivers (e.g., Cosumnes and Mokelumne rivers), and by developing floodplain habitat along the lower San Joaquin River, including a bypass in the Delta. It is worth noting that improving floodplain management for native fish is highly compatible with agricultural use of flooded lands (e.g., by keeping it in annual vegetation) and mosquito control (e.g., by having abundant juvenile fish and rapid drainage).”

This finding is developed in support of the objective stated in the following sections of the Water Code.

85302(c)(1). The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ... Viable populations of native resident and migratory species.

85302(c)(5). *The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem:...Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations.*

Additional Information:

Moyle, P. B., W.A. Bennett, W.E. Fleenor, and J.R. Lund. 2010. *Habitat Variability and Complexity in the Upper San Francisco Estuary*. Delta Solutions Center for Watershed Sciences, University of California, Davis.

Opperman, J. J., G. E. Galloway, J. Fargione, J. F. Mount, B. D. Richter, and S. Secchi. 2009. Sustainable floodplains through large-scale reconnection to rivers. *Science* 326: 1487 – 1488

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, K. Souza. 2007. The collapse of pelagic fishes in the upper San Francisco Estuary. *Fisheries* 32:270–277.

Jeffres, C. A., J. J. Opperman, and P. B. Moyle. 2008. Ephemeral floodplain habitats provide best growth conditions for juvenile Chinook salmon in a California river. *Environmental Biology of Fishes* 83: 449-458.

Jassby, A.D., W.J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel, and T.J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. *Ecological Applications* 5:272-289.

Feyrer, F., B. Herbold, S.A. Matern, and P.B. Moyle. 2003. Dietary shifts in a stressed fish assemblage: consequences of a bivalve invasion in the San Francisco Estuary. *Environmental Biology of Fishes* 67:277-288.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more “scientific credibility” are at the top of the list.⁹

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Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using ‘best available science’: a policy conundrum for the management of aquatic ecosystems</i> . <i>Marine and Freshwater Research</i> 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-5:

Current Instream Structures (e.g., Dams, Weirs, and Gates) Impair Local and Migratory Movement of Native Resident and Migratory Species in the Delta and Upstream Reaches.

Water management facilities in and upstream of the Delta, including dams, weirs, and gates, block or impair the movement of fish associated with the Delta, particularly anadromous species that require access to upstream reaches to meet life history requirements. Most of the major tributaries to the Delta have dams that block all access to upstream habitat (NMFS 2009). In and near the Delta, structures such as Fremont Weir, Lisbon Weir, and road crossings also present impediments to fish passage.

Safe and unobstructed migratory pathways are necessary for passage within riverine habitats and between riverine and estuarine habitats. Migratory habitat condition is strongly affected by the presence of physical barriers to movement, although other factors, such as water quantity and quality can also present effective barriers to migration. Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements (NMFS 2009). Migratory corridors for anadromous fish, including the lower reaches of the Sacramento and San Joaquin rivers and the Delta, must allow for the upstream passage of adult fish and the downstream emigration of juveniles.

This finding is developed in support of Water Code section 85302:

(e)(2) Establish migratory corridors for fish, birds, and other animals along selected Delta river channels.

(c)(2) The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Functional corridors for migratory species.

Additional Information:

NMFS. 2009. Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project. National Marine Fisheries Service Southwest Region. June 4, 2009.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-6:

Introduction of Exotic Plant and Animal Species Have Degraded the Quality of Habitat in the Delta.

Over 230 exotic species have become established in the ecosystem; at least 125 additional species are cryptogenic (not clearly identified as native or introduced). Cohen and Carlton (1995) note:

“Nonindigenous aquatic animals and plants have had a profound impact on the ecology of this region. No shallow water habitat now remains uninvaded by exotic species and, in some regions, it is difficult to find any native species in abundance. In some regions of the Bay, 100% of the common species are introduced, creating ‘introduced communities.’ In locations ranging from freshwater sites in the Delta, through Suisun and San Pablo Bays and the shallower parts of the Central Bay to the South Bay, introduced species account for the majority of the species diversity.”

Brazilian waterweed, water hyacinth, overbite clam, and Asian clam are four of the most significant invasive species currently affecting the Delta’s ecosystem. They alter habitat suitability, consume vast quantities of primary and secondary production, and alter species composition and food web structure. Brazilian waterweed and giant reed have significantly modified habitat structure and function for native species. Of the 58 species in the modern fish fauna of the Delta, approximately 30 are nonnative, including striped bass, various catfish species, and threadfin shad, which compete with and in some cases have completely displaced native resident fishes of this ecosystem.

A number of transport vectors or pathways have been identified for the introduction of exotic species to the Delta, including commercial shipping, commercial fishing, recreational, trade in live organisms, construction in aquatic environments, and water delivery and diversion systems. Invasive species cling to boat bottoms and fishing gear, construction equipment, floating debris, and docks. They inhabit ballast water on ships, and escape or are released from aquaculture activities, ornamental ponds, and aquariums.

This finding is developed in support of Water Code section 85302:

(c)(4) The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Reduced threats and stresses on the Delta ecosystem.

(e)(3) Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.

Additional Information:

Cohen, A.N. and J.T. Carlton. 1995. Biological Study. Nonindigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta. A Report for the U.S. Fish and Wildlife Service, Washington, DC and The National Sea Grant College Program, Connecticut, Sea Grant, NTIS Report Number PB96-166525.

Cohen, A.N. and J.T. Carlton. 1998. Accelerating invasion rate in a highly invaded estuary. *Science* 279:555-558.

Herbold, B. and P.B. Moyle. 1989. The Ecology of the Sacramento-San Joaquin Delta: a Community Profile. US Fish and Wildlife Service Biological Report 85(7.22) xi+106 pp.

The Bay Institute. 1998. From the Sierra-to-the-Sea: the Ecological History of the San Francisco Bay-Delta Watershed. Novato, California.

Resources Agency. 2008. California Aquatic Invasive Species Management Plan. Department of Fish and Game. January 2008.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-6:

Entrainment at Water Diversions In and Upstream of the Delta Adversely Affects Native Aquatic Species.

At the SWP and CVP export facilities, multiple factors influence the vulnerability of native fishes to entrainment, including their geographic distribution within the Delta and hydrodynamic factors, such as reverse flows in Old and Middle rivers. In addition to the CVP and SWP water export facilities located in the south Delta and various smaller facilities, there are numerous agricultural diversions in the Delta, many of which are not screened to exclude fish.

Large numbers of delta smelt and other fish are lost to the CVP and SWP water export facilities located in the south Delta. The risk of entrainment to delta smelt varies seasonally and among years. In addition, the CVP and SWP water export facilities and other diversions export phytoplankton, zooplankton, nutrients, and organic material that would otherwise support the base of the food web in the Delta, thus reducing food availability for delta smelt.

Both within and outside of the Delta, juvenile salmonids are more vulnerable to unscreened diversions than adults due to their size and behavior (i.e., moving downstream with the flow). Unscreened diversions in the upper Sacramento River are more likely to kill juvenile salmonids and green sturgeon than unscreened diversions in the lower Sacramento River due to their proximity to spawning areas where newly hatched fry and larvae have weak swimming abilities.

The U.S. Fish and Wildlife Service's *Biological Opinion on the Long-term Operations of the Central Valley Project and State Water Project* (USFWS 2010) states:

"The population-level effects of delta smelt entrainment vary; delta smelt entrainment can best be characterized as a sporadically significant influence on population dynamics. Kimmerer (2008) estimated that annual entrainment of the delta smelt population (adults and their progeny combined) ranged from approximately 10 percent to 60 percent per year from 2002-2006. Major population declines during the early 1980s (Moyle et al. 1992) and during the recent POD years (Sommer et al. 2007) were both associated with hydrodynamic conditions that greatly increased delta smelt entrainment losses as indexed by numbers of fish salvaged. However, currently published analyses of long-term associations between delta smelt salvage and subsequent abundance do not support the hypothesis that entrainment is driving population dynamics year in and year out (Bennett 2005; Manly and Chotkowski 2006; Kimmerer 2008)."

For salmonids, the National Marine Fisheries Service's *Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project* (NMFS 2009) concludes:

"Loss rates at the export facilities typically account for several hundred to several thousand individual wild fish per year from the different salmonid populations. As

previously discussed, the importance of these wild fish to the population is potentially greater than their actual numbers. These fish represent individuals who have survived the numerous stressors present in the system between their natal streams and the Delta, and therefore represent behavioral and physiological traits that are necessary for survival in the natural environment. Loss of these individuals represents a loss of survival traits that would be beneficial to the population as a whole.”

This finding is developed in support of Water Code section 85302:

(c)(4) The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem: ...Reduced threats and stresses on the Delta ecosystem.

(e)(3) Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.

Additional Information:

Bennett, W.A. 2005. Critical assessment of the delta smelt population in the San Francisco Estuary, California. San Francisco Estuary and Watershed Science [Internet] 3(2) <http://repositories.cdlib.org/jmie/sfews/vol3/iss2/art1>

Kimmerer, W.J. 2008. Losses of Sacramento River Chinook salmon and delta smelt to entrainment in water diversions in the Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science [online serial] Vol. 6, Issue 2 (June 2008), Article 2 <http://repositories.cdlib.org/jmie/sfews/vol6/iss2/art2>

Manly, B.F.J. and M. Chotkowski. 2006. Two new methods for regime change analyses. Arch. Hydrobiol. 167(1-4): 593-607.

Moyle, PB, Herbold, B, Stevens, DE, Miller LW. 1992. Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 121:67-77.

National Marine Fisheries Service (NMFS). 2009. Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project. National Marine Fisheries Service, Southwest Region June 4, 2009.

Sommer, T, C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The collapse of pelagic fishes in the upper San Francisco Estuary. Fisheries 32(6):270-277.

U.S. Fish and Wildlife Service (USFWS). 2010. Biological Opinion on the Long-term Operations of the Central Valley Project and State Water Project.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-6:

Current Flow Regimes Harm Native Species and Encourage Non-native Species
Through Their Effects on Turbidity, Salinity, Aquatic Plant Communities, and Nutrients.

Recent flow regimes in the Delta have contributed to the decline of native species and encouraged non-native species. Flows into and within the estuary affect turbidity, salinity, aquatic plant communities, and nutrients that are important to both native and non-native species. However, flows and habitat structure are often mismatched and now favor non-native species (SWRCB 2010). Flows benefit native aquatic species when they have more naturally variable frequency, magnitude, timing, duration, and rate of change across tidal to interannual timescales.

In its development of flow criteria for the Delta, the State Water Resources Control Board considered conclusions and recommendations made by the Delta Environmental Flows Group. The group noted in its key points that:

- *Flow related factors that affect public trust resources include more than just volumes of inflow and outflow and no single rate of flow can protect all public trust resources at all times. The frequency, timing, duration, and rate of change of flows, the tides, and the occurrence of overbank flows, all are important. Seasonal, interannual, and spatial variability in flows, to which native species are adapted, are as important as the quantity of flow. Biological responses to flows rest on combinations of quantity, timing, duration, frequency and how these inputs vary spatially in the context of a Delta that is geometrically complex, highly altered by humans, and fundamentally tidally driven.*
- *Recent flow regimes in the Delta have contributed to the decline of native species and encouraged non-native species. Flows into and within the estuary affect turbidity, salinity, aquatic plant communities, and nutrients that are important to both native and non-native species. However, flows and habitat structure are often mismatched and now favor non-native species.*
- *Flow is a major determinant of habitat and transport. The effects of flow on transport and habitat are controlled by the geometry of the waterways. Further, because the geometry of the waterways will change through time, flow regimes needed to maintain desired habitat conditions will also change through time. Delta inflow is an important factor affecting the biological resources of the Delta because inflow has a direct effect on flood plain inundation, in-Delta net channel flows, and net Delta outflows.*
- *Flow modification is one of the few immediate actions available to improve conditions to benefit native species. However, habitat restoration, contaminant and nutrient reduction, changes in diversions, control of invasive species, as well as flood plain inundation and island flooding all interact with flow to affect aquatic habitats.*

This finding is developed in support of the objective stated in the following section of the Water Code.

85302(e)(4). Restore Delta flows and channels to support a healthy estuary and other ecosystems.

Additional Information:

State Water Resources Control Board. 2010. Development of flow criteria for the Sacramento-San Joaquin Delta ecosystem. Resolution No. 2010-0039.

California Department of Fish and Game. 2010. Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta. Prepared pursuant to the Sacramento-San Joaquin Delta Reform Act of 2009. 130 pp. + appendices.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. *Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems*. Marine and Freshwater Research 61: 821-828.

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 6, p. 6-6:

Climate Change Has Altered and Will Continue to Alter Flow Regimes.

According to DWR (2008), climate change is already having a profound impact on water resources as evidenced by changes in snowpack, river flows and sea levels. While the exact conditions of future climate change remain uncertain, there is no doubt about the changes that have already happened. Analysis of paleoclimatic data (such as tree ring reconstructions of streamflow and precipitation) indicates a history of naturally and widely varying hydrologic conditions in California and the west, including a pattern of recurring and extended droughts. The average early spring snowpack in the Sierra Nevada decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage. During the same period, sea level rose 7 inches along California's coast. California's temperature has risen 10 F, mostly at night and during the winter, with higher elevations experiencing the highest increase. A disturbing pattern has also emerged in flood patterns; peak natural flows have increased on many of the state's rivers during the last 50 years.

Based upon historical data and modeling, the Sierra snowpack will experience a 25 to 40 percent reduction from its historic average by 2050 (DWR 2008). Climate change is also anticipated to bring warmer storms that result in less snowfall at lower elevations, reducing the total snowpack. Warming temperatures, combined with changes in rainfall and runoff patterns will increase the frequency and intensity of droughts. Rising snowlines caused by climate change will allow more of the Sierra Nevada watersheds to contribute to peak storm runoff. High frequency flood events (e.g., 10-year floods) in particular will likely increase with a changing climate. In addition, sea levels are rising, and it is generally accepted that this trend will continue, although the rate of change is unclear because of the ongoing scientific uncertainty about the melting of ice sheets and the potential for abrupt changes in ocean conditions. Recent peer-reviewed studies estimate a rise of between 7 to 55 inches by 2100 along California's coast (e.g., Rahmstorf 2007).

This finding is developed in support of the objective stated in the following section of the Water Code.

85302(e)(4). Restore Delta flows and channels to support a healthy estuary and other ecosystems.

Additional Information:

DWR. 2008. Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water. Sacramento, CA. 34 pp.

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

Rahmstorf, S. 2007. A semi-empirical approach to projecting future sea level. Science. 10 315(5810):368-370.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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Basis of Findings

Chapter 8 –Reduce Risks to People, Property, and State Interests in the Delta

First Staff Draft Delta Plan

Reduction of Risk by Promoting Effective Emergency Preparedness	8-1
Reduction of Risk by Promoting Strategic Levee Investments	8-9
Reduction of Risks to Delta Infrastructure, Transportation, and Transmission Corridors Across the Delta.....	8-19

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-3:

There is no State Emergency Response Plan for the Delta.

The legislature emphasized the need for Delta emergency planning in the face of continuing risks of levee failure (Water Code section 12994(a)):

(2) Even with active levee maintenance, the threat of delta levee failures from earthquake, flood, or poor levee foundation, will continue to exist.

(3) Because of this threat of failure, and the potential need to mobilize people and equipment in an emergency to protect delta levees and public benefits, the department needs authority that will enable it to act quickly.

Although State and local agencies recognize the need to plan and prepare for emergencies in the Delta, only concept papers and preliminary recommendations have been completed to date. In 2007, the Department of Water Resources published the *Delta Interim Emergency Operations Plan*, a concept paper that laid a foundation for a comprehensive plan by providing context and defining circumstances for a future planning process. Updates to the interim plan and preparatory work to establish rock stockpile facilities on the periphery of the Delta were completed in 2008.

The Sacramento-San Joaquin Delta Emergency Preparedness Act of 2008 required development of a multi-jurisdictional emergency preparedness and response strategy for the Delta region. This work is underway by the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force, led by the California Emergency Management Agency and including representatives from the Delta Protection Commission, the Department of Water Resources, and an emergency management representative from Sacramento, San Joaquin, Yolo, Solano, and Contra Costa counties.

On the local level, each county in the Delta has established an Office of Emergency Services, a central authority for coordinating emergency operations activities in a defined area; however, of all Delta counties, only San Joaquin County has developed an evacuation plan that identifies specific responsibilities and procedures that would be used during emergencies. No individual county has completed an emergency response plan focused solely on the Delta area.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

(b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.

Additional Information:

California Emergency Management Agency, 2010. *Emergency Response in the Delta*. Presentation to the Delta Stewardship Council. November 18.

California Department of Water Resources, 2008. *Enhanced Delta Emergency Response Update 2007-09*. January 18.

California Department of Water Resources, 2007. *Delta Interim Emergency Operations Plan Concept Paper*. April.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-3:

Emergency preparedness is the first line of flood defense and local agencies are the primary responsible agents.

The legislature emphasized the need for Delta emergency planning in the face of continuing risks of levee failure (Water Code section 12994(a)):

(2) Even with active levee maintenance, the threat of delta levee failures from earthquake, flood, or poor levee foundation, will continue to exist.

(3) Because of this threat of failure, and the potential need to mobilize people and equipment in an emergency to protect delta levees and public benefits, the department needs authority that will enable it to act quickly.

In their Vision and Strategic Plan, the Delta Vision Blue Ribbon Task Force found that coordinated emergency preparedness and response is vital to public safety in the Delta, and the responsibility of all levels of government:

The protection of human life is a fundamental responsibility of government at all levels. In a disaster-prone area like the Delta, it is imperative that federal, state and local governments—and the citizens themselves—be prepared for a variety of emergency situations, including those in which rapid evacuation or rescue from cold floodwaters are necessary. Emergency response should be routinely tested and practiced to ensure that critical operations can proceed smoothly when needed.

Preparation activities undertaken in advance of an emergency include developing operational capabilities, training, preparing plans, and improving public information and communication systems. Local agencies have a primary role in this preparation. Although a county's Office of Emergency Services (OES) has responsibility to plan for and coordinate emergency responses, Delta reclamation districts (RDs) usually have the primary day-to-day responsibility for the integrity, improvement, operations, and maintenance of the Delta levees. They are the first responders relative to Delta flood hazards and, therefore, have primary responsibility for preparedness and immediate response to flood threats. For some project levees, the State of California has this responsibility or works very closely with the local RD, because of the assurances that have been given to the federal government.

In high-hazard situations, the RD is generally the organizer of levee patrols, and first to respond when there is an imminent danger. Local law enforcement (usually the county sheriff or a deputy) and other local organizations, such as volunteer fire departments and the RD, would be active participants in facilitating evacuation, once the county's OES has been notified.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

(b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.

Additional Information:

California Water Code section 12994(a).

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October. pp. 37, 103.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-3:

Recent floods stimulate emergency response planning, but the process is far too slow.

In 2008, the Delta Vision Blue Ribbon Task Force found that:

Earthquakes, river floods, “sunny-day” levee failures, and continuing subsidence and sea level rise all pose substantial risks to people, property, and infrastructure in the Delta. Emergency response capabilities must be thoroughly assessed and rapidly strengthened.
(Delta Vision Strategic Plan, p. 107, emphasis added)

Since 1996, a variety of emerging trends have influenced emergency management, including an increasing diversity of California’s population, greater vulnerability to floods and wildfires as development expands, and the need for more emphasis on disaster recovery and hazard mitigation efforts to reduce disaster impact. At the national level, significant events such as Hurricane Katrina captured the world’s attention and have widely influenced emergency management today. Since this disaster, some progress is evident in California; the Department of Water Resources works with local and county emergency responders in the Delta under the Standardized Emergency Management System in the event of a flood, and an emergency exercise is planned in the Delta in the future, but more progress is needed. Although initiated by the Sacramento-San Joaquin Delta Emergency Preparedness Act of 2008, no comprehensive emergency response plan for the Delta has yet been completed.

This finding is developed in support of Water Code section 85305:

- (a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.*
- (b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.*

Additional Information:

California Emergency Management Agency, 2009. *State of California Emergency Plan*. July. p. vi.

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October. p. 103.

California Emergency Management Agency, 2010. *Emergency Response in the Delta*. Presentation to the Delta Stewardship Council. November 18.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.³

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
General scientific reports and publications	Standard reports and analyses	Informal, internal/external	Medium	Available from source
Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
Anecdotal evidence	Personal observations and beliefs	Limited to none	Fast	Available from individuals and groups
¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-3:

Subsided Delta islands are at the highest risk of flooding and are likely to succumb to flood over the coming decades.

Land subsidence on the interior of islands and tracts has created large areas below sea level. Today, some areas are as much as 25 feet below sea level. The water surrounding these subsided Delta islands is held back 365 days per year by earthen levees. Flooding is possible at any time.

Recently the California Departments of Water Resources and Fish and Game (2008, p. 12) reported:

The last 100 years of land subsidence has made the Delta islands deeper and resulted in building levees higher. These levees are more susceptible now to failure during an earthquake than they were in 1906.

Land subsidence in some areas continues at the rate of 0.5 to 1.5 inches of soil loss per year. The agencies forecasted that over the next 200 years, some areas of the central Delta, could subside by another 18 feet below existing land levels if current land use practices continue to deplete peat soils and increase stress on existing levees.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

(b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.

Additional Information:

California Department of Water Resources and Department of Fish and Game, 2008. *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta*. Prepared pursuant to requirements of Assembly Bill 1200. January. p. 12.

California Department of Water Resources. 2009. *Delta Risk Management Strategy Phase 1 Report*. March. pp. 2-4, 2-5

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.⁴

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-4:

The Delta is floodprone.

The California legislature found the Delta to be inherently floodprone:

The Legislature further finds and declares that the leveed islands and tracts of the delta and portions of its uplands are floodprone areas of critical statewide significance due to the public safety risks and the costs of public emergency responses to floods, and that improvement and ongoing maintenance of the levee system is a matter of continuing urgency to protect farmlands, population centers, the state's water quality, and significant natural resource and habitat areas of the delta. The Legislature further finds that improvements and continuing maintenance of the levee system will not resolve all flood risks and that the delta is inherently a floodprone area...

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

This finding is also developed in support of Water Code section 85306:

The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and non-project levees.

This finding is also developed in support of Water Code section 85307:

(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

(b) The Delta Plan may include local plans of flood protection.

Additional Information:

Johnston-Baker-Andal-Boatwright Delta Protection Act of 1992.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.⁵

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-4:

Delta levees are also threatened by earthquakes.

Recently the California Departments of Water Resources and Fish and Game (2008, p. 12) reported:

The 7.8 magnitude 1906 San Francisco earthquake was a significant event, but relative levee heights were much lower then. The last 100 years of land subsidence has made the Delta islands deeper and resulted in building levees higher. These levees are more susceptible now to failure during an earthquake than they were in 1906. In addition, seismic activity since the 1906 earthquake has been reduced from the historical events preceding that earthquake. Due to the lower number of significant earthquakes, stress is building, increasing the chance of a large earthquake. On the basis of research conducted since the 1989 Loma Prieta earthquake, the U.S. Geological Survey and other scientists conclude that there is a 62 percent probability of at least one magnitude 6.7 or greater quake, capable of causing widespread damage, striking the San Francisco Bay region by 2032.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

This finding is also developed in support of Water Code section 85306:

The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and non-project levees.

This finding is also developed in support of Water Code section 85307:

(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

(b) The Delta Plan may include local plans of flood protection.

Additional Information:

California Department of Water Resources and Department of Fish and Game, 2008. *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta*. Prepared pursuant to requirements of Assembly Bill 1200. January. p. 12.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. *Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems*. Marine and Freshwater Research 61: 821-828.

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-4:

Levees do not eliminate risk—levees reduce risk.

In Water Code 9601, the California legislature recognizes that:

(b) ... by their nature, levees, which are earthen embankments typically founded on fluvial deposits, cannot offer complete protection from flooding, but can decrease its frequency.

Most Delta levees were built before modern engineering techniques were common, and many of these levees do not meet today's standards for stability during earthquakes or large floods. Also, due to land subsidence, most Delta islands sit below sea level, and levees must hold back water constantly, essentially acting as a dam. As subsidence increases and the difference between the land and water surface increases, levees become more susceptible to failure.

Levees in the Delta are also subject to risks from high wind waves, erosion, and undetected problems such as burrowing animals. Levees face more challenges in the future from sea level rise, increasing storm events, higher snowmelt flows due to climate change effects, and seismic activity.

History has shown that unavoidable structural failures in the system will occur due to extraordinary events, imperfect knowledge, and imperfect materials. (DWR, 2009a) A levee system can, however, decrease the frequency of floods and lessen their adverse economic and social impacts.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

This finding is also developed in support of Water Code section 85306:

The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and non-project levees.

This finding is also developed in support of Water Code section 85307:

(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

(b) The Delta Plan may include local plans of flood protection.

Additional Information:

California Department of Water Resources and Department of Fish and Game, 2008. *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta*. Prepared pursuant to requirements of Assembly Bill 1200. January. p. 4-5, 10.

California Department of Water Resources. 2009a. *Historical Reference Document for the State Plan of Flood Control*. May 15. p. 1-1.

Not Reviewed or Approved by Delta Stewardship Council
Administrative Draft: Subject to Revision

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.⁷

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-4:

Levee safety status quo is unacceptable.

In 2009, the National Committee on Levee Safety submitted recommendations and a strategic plan for a National Levee Safety Program. The Committee reflected on the history of levee safety and what had become the status quo (National Committee of Levee Safety, 2009, p. 3):

The 1960s through the 1980s ushered in new national policies relating to flood insurance, cost sharing for flood control projects, and new owner/operator responsibilities that had the unintended effect of targeting levee designs to only the 1%-annual-chance (100-year) event. This then became the beginning of a dangerous and inappropriate association of the 1%-annual-chance event as a safety standard. Our relative complacency during the numerous natural events that continued to wreak economic catastrophes in recent decades was shattered in 2005 in New Orleans. It was the catastrophic loss of life associated with Hurricane Katrina that once again refocused the nation and became the catalyst for the National Levee Safety Act and this report.

The current levee safety reality for the United States is stark—uncertainty in location, performance and condition of levees and a lack of oversight, technical standards, and effective communication of risks. A look to the future offers two distinct possibilities: one where we continue the status quo and await the certainty of more catastrophes or one where we take reasonable actions and investments in a National Levee Safety Program that turns the tide on risk growth. We strongly recommend the latter.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

This finding is also developed in support of Water Code section 85306:

The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and non-project levees.

This finding is also developed in support of Water Code section 85307:

(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

(b) The Delta Plan may include local plans of flood protection.

Additional Information:

National Committee of Levee Safety, 2009. *Draft Recommendations for a National Levee Safety Program*. January. p. 3.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-5:

Setback levees provide multiple benefits.

Setback levees are embankments positioned some distance from the edge river channel. This levee design typically allows rivers to meander within limits, providing additional floodplain and flood control capacity. Realigning existing levees along rivers upstream of the Delta could reduce the threat of Delta levee failure by increasing upstream storage and attenuating flood flows. Risk of levee failure could also be reduced by relocating some Delta levees back to areas with more stable levee foundation material than their existing sites. As an added benefit, setback levees upstream can also augment existing riparian habitat for native species.

In their Interim *Comprehensive Study* on the Sacramento and San Joaquin River Basins (2002), The U.S. Army Corps of Engineers identified potential measures that would reduce flood damages and restore the ecosystem. Among the recommended measures, the agency found (p. 82):

Relocating levees at specific locations where existing levees create constrictions in floodplain width and/or are at risk of failing due to erosion and bank failure could improve conveyance capacity, reduce water surface elevation, improve ecosystem functions, create new waterside areas for habitat restoration, reduce flow velocities, and decrease the need for expensive bank protection.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness.

This finding is also developed in support of Water Code section 85306:

The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and non-project levees.

This finding is also developed in support of Water Code section 85307:

(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

(b) The Delta Plan may include local plans of flood protection.

Additional Information:

U.S. Army Corps of Engineers, 2002. *Sacramento and San Joaquin River Basins, California, Comprehensive Study, Interim Report*. December 20. pp. 82-83.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-5:

The Delta is a critical utility and transportation corridor.

Former Governor Schwarzenegger declared in Executive Order S-17-06 that:

...the Delta is intersected by highways, roads, and utility lines critical to regional, state and interstate commerce and economy.

...failure of Delta levees can have devastating consequences on farms, communities, roads, railways, power and fuel transmission lines, water conveyance and quality, wildlife resources, and the local and state economy.

California's economy, including the economy of the Delta, relies on an extensive and costly infrastructure system that includes roads, highways, railroads, water storage and conveyance, pipelines, and electrical power production. Due to the Delta's location between major population areas, its unique water and gas resources, and its flat rural terrain, the Delta has high value as a utility and transportation corridor. The loss of these services and infrastructure may have economic consequences to the Delta and to the state as a whole.

Key transportation routes cross through or near the Delta from the Central Valley to the Bay Area, including Interstates 5 and 80 and State Highways 4, 12, and 160. These routes are heavily used by both residents and businesses and are at risk for closure if flooding or a levee breach occurred. Flooded highways would require travelers to use alternate routes until floodwaters are removed and roads cleared of debris and repaired. Types of costs associated with this include increased travel time, expense, and congestion to take alternate routes, or simply lost trips and lost business.

Electric transmission lines, natural gas pipelines, and petroleum products pipelines all cross the Delta. Interruption of these services would be costly and disruptive. For example, PG&E operates natural gas transmission and storage facilities within the Delta. The company's largest natural gas storage field is located on MacDonald Island, and PG&E is operating the storage through a single pipeline. Failure of this line could result in an extended outage which could lead to widespread economic consequences. PG&E estimated the loss of the use of the natural gas storage would cost \$114.4 million per month under certain seasonal conditions.

The value of utilities and transportation in the Delta in terms of the economic consequences of the lost use of these structures and services is estimated in the *Economic Consequences Technical Memorandum*, developed for DWR's Delta Risk Management Strategy. (2008)

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) *The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.*

This finding is also developed in support of Water Code section 85309:

The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall prepare a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for consideration for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

Additional Information:

California Department of Water Resources, 2008. *Delta Risk Management Strategy Technical Memorandum: Economic Consequences*. Prepared by URS Corporation/Jack R. Benjamin & Associates, Inc. May. pp. 1, 43-62

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹⁰

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-5:

The Delta provides critical corridors for infrastructure serving populations and markets beyond the Delta.

Former Governor Schwarzenegger declared in Executive Order S-17-06 that:

...the Delta is intersected by highways, roads, and utility lines critical to regional, state and interstate commerce and economy.

...failure of Delta levees can have devastating consequences on farms, communities, roads, railways, power and fuel transmission lines, water conveyance and quality, wildlife resources, and the local and state economy.

California's economy, including the economy of the Delta, relies on an extensive and costly infrastructure system that includes roads, highways, railroads, water storage and conveyance, pipelines, and electrical power production. Due to the Delta's location between major population areas, its unique water and gas resources, and its flat rural terrain, the Delta has high value as a utility and transportation corridor. The loss of these services and infrastructure may have economic consequences to the Delta and to the state as a whole.

Infrastructure within the Delta includes more than 500 miles of transmission lines and 60 substations within the Delta boundaries that carry power within California as well as between regions of the western United States. Three interstate freeways (Interstate 5, Interstate 80, and Interstate 580); major state highways such as State Routes 4, 12, and 160; major county roads; and more than 50 bridges, including approximately 30 drawbridges, provide major transportation and trucking routes through or near the Delta. The Amtrak San Joaquin route from Bakersfield to Sacramento/Oakland crosses through the Delta. (Delta Protection Commission, 2010)

Critical gasoline and aviation fuel pipelines cross the Delta, delivering petroleum products from Bay Area refineries to depots in Sacramento and Stockton for distribution to Northern California and Nevada. They provide approximately 50 percent of the transportation fuel used in that region. Disruption of aviation fuel lines could have global impacts if international airports are unable to obtain adequate fuel.

The Mokelumne Aqueduct, consisting of three pipelines, is the main municipal water conveyance facility for 1.3 million people in the East Bay Municipal Utility District. The aqueduct crosses five Delta islands or tracts protected by levees.

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the

Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

This finding is also developed in support of Water Code section 85309:

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Additional Information:

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

California Department of Water Resources, 2008. *Delta Risk Management Strategy Technical Memorandum: Economic Consequences*. Prepared by URS Corporation/Jack R. Benjamin & Associates, Inc. May. pp. 1, 43-62

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. *Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems*. Marine and Freshwater Research 61: 821-828.

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-6:

Inland ports connected to the Delta are important to the region's economy.

Several million tons of diversified products are shipped through the Delta each year by way of the Stockton and Sacramento Deep Water Ship channels that traverse the Delta. The Stockton channel is 35 feet deep and can handle 55,000-ton class vessels with full loads, and more than 300 ships and barges used the channel in 2005. The Sacramento ship channel is 30 feet deep, and expansion is planned.

In the Delta Protection Act of 1992, the legislature declared (Public Resource Code 29711):

The inland ports of Sacramento and Stockton constitute economic and water dependent resources of statewide significance, fulfill essential functions in the maritime industry, and have long been dedicated to transportation, agricultural, commercial, industrial, manufacturing, and navigation uses consistent with federal, state, and local regulations, and that those uses should be maintained and enhanced.

DWR (2008) estimated that if the ports were closed due to a flood event, additional costs would be incurred to move the freight by rail instead of by ship until the ports or channels could be reopened.

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

This finding is also developed in support of Water Code section 85309:

The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall prepare a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for consideration for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

Additional Information:

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25. p. 32.

California Department of Water Resources, 2008. *Delta Risk Management Strategy Technical Memorandum: Economic Consequences*. Prepared by URS Corporation/Jack R. Benjamin & Associates, Inc. May. p. 43.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹²

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
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Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-6:

The Mokelumne Aqueduct, which crosses the Delta, is a major source of water for the East Bay.

The Mokelumne Aqueduct, consisting of three pipelines (65-inch, 67-inch, and 87-inch diameter), is the main municipal water conveyance facility for 1.3 million people in the East Bay Municipal Utility District (EBMUD). The aqueduct carries water from the Calaveras watershed across Orwood Tract, Woodward Island, Jones Tract, Roberts Island, and Sargent-Barnhart Tract in the Delta to the East Bay. Approximately 90 percent of EBMUD's supply is from the Mokelumne River.

The aqueduct could be vulnerable to strong seismic activity in the vicinity of its right-of-way. Alternative supplies or local storage could be used in lieu of this supply for up to 1 month. For longer outages of 6 months, EBMUD estimates it would experience a 25 percent shortage in deliveries. (DWR, 2008)

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

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Additional Information:

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Science Assessment:

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-6:

Major interstate, state, and county roads cross through the Delta.

Former Governor Schwarzenegger declared in Executive Order S-17-06 that:

...the Delta is intersected by highways, roads, and utility lines critical to regional, state and interstate commerce and economy.

Major interstate freeways, state highways, and county roads cross the Delta and Suisun Marsh. These include:

- Interstates: I-5, I-80, and I-580
- State Routes: SR-4, SR-12, SR-84, SR-113, SR-160, SR-220
- County Roads: E9, E13, E19, J2, J3, J8, J11

Originally meant for lower traffic volumes at moderate speeds, the state highways are now heavily used for regional trucking, recreational access, and commuting.

Truck routes in the Delta and Suisun Marsh are primarily located on major state and county highways and major local arterials. Major routes for large trucks (known as STAA, or Surface Transportation Assistance Act routes) in the Delta and Suisun Marsh include portions of all major interstates and state routes. Other truck route classifications in the Delta include portions of SR-160, SR-84, SR-4, and SR-220.

In addition, more than 50 bridges (including approximately 30 drawbridges) provide major transportation and trucking routes through or near the Delta. The longest spanned bridge in the Delta and Suisun Marsh is the Antioch Bridge, which is a part of SR-160 and connects Contra Costa County with Sacramento County.

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

This finding is also developed in support of Water Code section 85309:

The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall prepare a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for consideration for incorporation into the Delta Plan.

In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

Additional Information:

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25. pp. 31-32.

California Department of Water Resources, 2008. *Delta Risk Management Strategy Technical Memorandum: Economic Consequences*. Prepared by URS Corporation/Jack R. Benjamin & Associates, Inc. May. pp. 1, 47-52

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹⁴

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-6:

Critical freight and passenger rail infrastructure crosses the Delta.

Three major railroads cross the Delta carrying passengers and freight. The Union Pacific Railroad (UPRR) runs two lines, one between Oakland and Sacramento and another between Fremont and Stockton. The Burlington-Northern and Santa Fe (BNSF) Railroad services Stockton and Bakersfield.

- The UPRR Oakland to Sacramento line carries both freight and passenger service. Amtrak Capitol Corridor passenger service consists of about 16 round-trip intercity trains plus 4 long-distance trains daily, approximately 1.3 million passengers per year. Annual revenues are approximately \$46 million. The freight service ships approximately 1500 box cars per day to and from ports in the Bay Area along this route.
- The UPRR Fremont to Stockton line carries 11 trains per day, consisting of 6 passenger and 5 freight. The Fremont New United Motor Manufacturing Inc. plant depends on this freight line, sending shipments in about 500 freight cars per day.
- The BNSF line to Stockton is a major freight line, similar to the UPRR line from Oakland to Sacramento. Amtrak also operates an intercity passenger service on this railroad from Oakland through Port Chicago to Stockton. Four round-trips generate passenger revenues of \$27 million per year. The San Joaquin service runs along BNSF tracks toward Bakersfield and UPRR tracks toward Oakland. The San Joaquin service offers 4 daily round trips between Bakersfield and Oakland and 2 daily round trips between Bakersfield and Sacramento.

In addition, companies such as the Sierra Northern Railway use existing short-line tracks for inter-regional freight and passenger services. The Altamont Commuter Express (ACE) provides heavy passenger rail service between Stockton and San Jose and has shared rights to operate on UPRR tracks. In the Delta, ACE service runs between Stockton and Tracy in San Joaquin County.

Using BNSF estimates, DWR (2008) suggested that closure of one of the major railway lines could result in an additional 3,700 trucks per day on the highways around the Delta. Growth is also anticipated. The Sacramento Area Council of Governments estimates that rail cars into and through Sacramento will grow by 1.9 percent per year from 2003 through 2020. (DWR, 2008)

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) *The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.*

This finding is also developed in support of Water Code section 85309:

The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall prepare a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for consideration for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

Additional Information:

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25. pp. 31-32.

California Department of Water Resources, 2008. *Delta Risk Management Strategy Technical Memorandum: Economic Consequences*. Prepared by URS Corporation/Jack R. Benjamin & Associates, Inc. May. pp. 58-62

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-6:

Water distribution systems within and crossing the Delta are critical to the state's water supply.

The state relies on water infrastructure in the Delta, and the Delta is the heart of critical water supply issues in California. Former Governor Schwarzenegger declared in Executive Order S-17-06:

...the Delta is the hub of California's two largest water distribution systems, the federal Central Valley Project and State Water Project, and at least 7,000 other permitted water diverters have developed water supplies from the watershed feeding the Bay-Delta estuary, providing drinking water to about 23 million people and irrigation water to about 7 million acres of highly productive agricultural lands;

...failure of Delta levees can have devastating consequences on farms, communities, roads, railways, power and fuel transmission lines, water conveyance and quality, wildlife resources, and the local and state economy.

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

This finding is also developed in support of Water Code section 85309:

The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall prepare a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for consideration for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

Additional Information:

California Department of Water Resources, 2008. *Delta Risk Management Strategy Technical Memorandum: Economic Consequences*. Prepared by URS Corporation/Jack R. Benjamin & Associates, Inc. May. pp. 1, 43-62

California Department of Water Resources, 2009. *Delta Risk Management Strategy Phase 1 Report*. March. pp. 2-1 through 2-6.

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Science Assessment:

Analyses are pending but will address:

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 8, p. 8-6:

Climate change threatens important infrastructure in the Delta.

Long term impacts of climate change, including sea level rise, salt water intrusion, flooding, levee failure, or reductions in water supplies will threaten the viability of maintaining infrastructure and industry in the Delta. For example, rising groundwater levels could threaten the integrity and effective operation of many of the Delta's underground pipelines. Delta industries would be severely impacted by water quality degradation due to a number of factors such as sea level rise, salt water intrusion, flooding, or reductions in water supplies.

The Resources Agency's 2009 Climate Adaptation Strategy (2009) identified several climate change related risks to infrastructure, many of which apply to the Delta. For example:

Winter storms, especially if coinciding with earlier snowmelt and high runoff, can cause flooding and damage to transmission lines, overloading and damage of wastewater treatment facilities, as well as physical damage to culverts, canals, tunnels, coastal highways, runways, and railways, and associated business interruptions.

Sea-level rise is likely to cause the greatest impacts on California's infrastructure, including more frequent storm-related flooding of airports, seaports, roads, and railways in floodplains due to higher sea levels.

As sea level rises at a faster pace and coastal storm surges increase, existing fortifications will be increasingly inadequate and need to be raised, and areas previously not at-risk will become at risk.

The Bay-Delta levee system...is exposed to increases in the intensity and coincidence of river flooding-related forces combined with increased sea-level rise-related bayside stress.

One study conducted for the 2009 California Impacts Assessment found that about \$100 billion in structures, contents, and infrastructure along the California coast and San Francisco Bay and Delta may be at risk of storm-related inundation by 2100 due to projected increases in mean sea level.

This finding is developed in support of Water Code section 85307:

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

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Additional Information:

California Natural Resources Agency, 2009. *2009 Climate Adaptation Strategy*. Prepared in response to Executive Order S-13-2008.

California Department of Water Resources, 2009. *Delta Risk Management Strategy Phase 1 Report*. March. pp. 2-1 through 2-6.

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

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Basis of Findings

Chapter 9 –Protect and Enhance the Unique Cultural, Recreational, Natural Resources, and Agricultural Values of the California Delta as an Evolving Place

First Staff Draft Delta Plan

Protect and Enhance Unique Cultural Values of the Delta as an Evolving Place	9-1
Protect and Enhance Unique Recreational Values of the Delta as an Evolving Place	9-21
Protect and Enhance Unique Agricultural Values of the Delta as an Evolving Place	9-31
Reduction of Risk by Promoting Appropriate Land Uses	9-47

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-3:

The Delta has a unique culture and heritage based on its distinctive natural and agricultural history.

The California legislature has repeatedly found the Delta to be a unique and significant place based on its distinctive natural resource and agricultural history:

The Sacramento-San Joaquin Delta is a unique natural resource of local, state, and national significance. At 1,300 square miles, the Delta is the largest estuary on the west coast of North and South America. Its rivers and labyrinths of sloughs and channels are home to 750 species of plants and wildlife as well as 55 species of fish, provide habitat for 700 native plant and animal species, and are part of the Pacific Flyway. The Delta contains more than 500,000 acres of agricultural land, with unique soils, and farmers who are creative and utilize innovative agriculture... (Public Resources Code section 32301(a)-(d))

...the delta's uniqueness is particularly characterized by its hundreds of miles of meandering waterways and the many islands adjacent thereto. (Water Code section 12981)

The Delta's history is rich with a distinct natural, agricultural, and cultural heritage. It is home to the community of Locke, the only town in the United States built primarily by early Chinese immigrants. Other legacy communities include Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, and Walnut Grove. (Public Resources Code section 32301(f))

The Delta Vision Blue Ribbon Task Force (2008, p. 25) also described the Delta's value to the state:

The Delta's value is far greater than its environmental and economic worth to the state. It is a community with a distinct natural and cultural heritage. The Delta should continue to thrive not only as the hub of the state water system and the West's largest estuary, but for its own sake.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October. p. 24-27, 59.

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-3:

The Delta is significant to the state and nation as a cultural place and as an important ecosystem and water source.

The California legislature described the Delta's significant culture, ecosystem, and its important source of water to the state in Public Resources Code section 32301:

(a) The Sacramento-San Joaquin Delta is a unique natural resource of local, state, and national significance.

(b) At 1,300 square miles, the Delta is the largest estuary on the west coast of North and South America.

(c) Its rivers and labyrinths of sloughs and channels are home to 750 species of plants and wildlife as well as 55 species of fish, provide habitat for 700 native plant and animal species, and are part of the Pacific Flyway.

(h) In addition, the Delta provides water to more than 25 million Californians and three million acres of agricultural land...

The legislature also described the Delta's rich cultural heritage in Public Resources Code section 32301:

(f) The Delta's history is rich with a distinct natural, agricultural, and cultural heritage. It is home to the community of Locke, the only town in the United States built primarily by early Chinese immigrants. Other legacy communities include Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, and Walnut Grove.

Former Governor Schwarzenegger declared the importance of the Delta as a statewide water source in Executive Order S-17-06:

The Delta is the hub of California's two largest water distribution systems, the federal Central Valley Project and State Water Project, and at least 7,000 other permitted water diverters have developed water supplies from the watershed feeding the Bay-Delta estuary, providing drinking water to about 23 million people and irrigation water to about 7 million acres of highly productive agricultural lands.

The Delta Vision Blue Ribbon Task Force (2008, p. 25) emphasized the Delta's value to the state and nation:

The Delta's value is far greater than its environmental and economic worth to the state. It is a community with a distinct natural and cultural heritage. The Delta should continue to thrive not only as the hub of the state water system and the West's largest estuary, but for its own sake.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October. p. 24-27, 59.

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Science Assessment:

Analyses are pending but will address:

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-3:

The Delta supports a unique combination of environmental and economic resources that provide the basis for much of its local economy.

The environmental and economic resources of the Delta are interdependent. The Delta's land supports vital energy, transportation, communications facilities, and recreation and tourism opportunities. Rich peat soils in the central Delta and the mineral soils in the higher elevations support Delta agriculture. Delta waterways provide water conveyance for agriculture and urban uses, and also support numerous opportunities for recreation, such as boating, kayaking, and fishing, which support the Delta economy. Navigable waterways in the Delta are available for public access and currently make up the majority of recreational opportunities.

The Delta Protection Commission's Final Draft Economic Sustainability Plan Framework Study (2010) describes the link between the Delta's culture and environment with its regional economy:

The Delta's cultural, recreational, natural resource, and agricultural values are inextricably linked to economic activities that are carried out in the Delta, including farming, recreation, and tourism.

The Delta Protection Commission's *Final Draft Economic Sustainability Plan Framework Study* (2010) states that the key drivers of the Delta economy are the demand for agricultural products and the demand for tourism and recreation. These drivers generate activity in many business sectors associated with the Delta environment, including agriculture, food services, arts, entertainment, recreation, retail, manufacturing, and other services. These business sectors support other sectors within the Delta, which in turn support other business activity in surrounding regions.

Public Resources Code section 29703 describes other interdependencies of economic and environmental resources:

(b) The agricultural land of the delta, while adding greatly to the economy of the state, also provides a significant value as open space and habitat for water fowl using the Pacific Flyway, as well as other wildlife, and the continued dedication and retention of that delta land in agricultural production contributes to the preservation and enhancement of open space and habitat values.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October. p. 24-27.

Delta Protection Commission, 2010. *Economic Sustainability Plan Framework Study, Volume I: Framework for a Delta Economic Sustainability Plan*. Final Draft. December 6.

Not Reviewed or Approved by Delta Stewardship Council
Administrative Draft: Subject to Revision

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.³

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
General scientific reports and publications	Standard reports and analyses	Informal, internal/external	Medium	Available from source
Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
Anecdotal evidence	Personal observations and beliefs	Limited to none	Fast	Available from individuals and groups
¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-3:

Over the past 40 years, substantial urbanization has occurred along the periphery of the Delta and within the Secondary Zone of the Delta.

During the past 40 years, development within the Delta has occurred in unincorporated county areas (such as Discovery Bay), adjacent to historic cities (such as Brentwood and Oakley), and major Central Valley cities (such as Sacramento, Stockton, and Lathrop).

The Delta Protection Commission's Land Use and Resource Management Plan states:

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the secondary zone to impact the Primary Zone.

An illustration of how land use patterns have changed over time can be seen in Figures 1 and 2. The primary changes between 1984 (which was six years before the Delta Protection Act of 1992) and 2008 was the creation of wetlands on major areas of Liberty and Bradford Islands and increased urban land uses on the periphery of the Delta near West Sacramento, Oakley, Brentwood, Tracy, and Lathrop. Current local and State policies allow for continued development around periphery of urban areas and on agricultural land instead of infill within existing city boundaries.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

California Department of Conservation. Farmland Mapping and Monitoring Program GIS data, 1984-2008.

Delta Protection Commission, 2010. *Land Use and Resource Management Plan*. February 25. p. 7.

CH2M HILL. 2010. *Delta as a Place: Agriculture White Paper*. Prepared for consideration by the Delta Stewardship Council. December 6.

Figure 1
Urban and Agricultural Land Use in and near the Delta and Suisun Marsh in 1984
Source: Farmland Mapping and Monitoring Program 1984

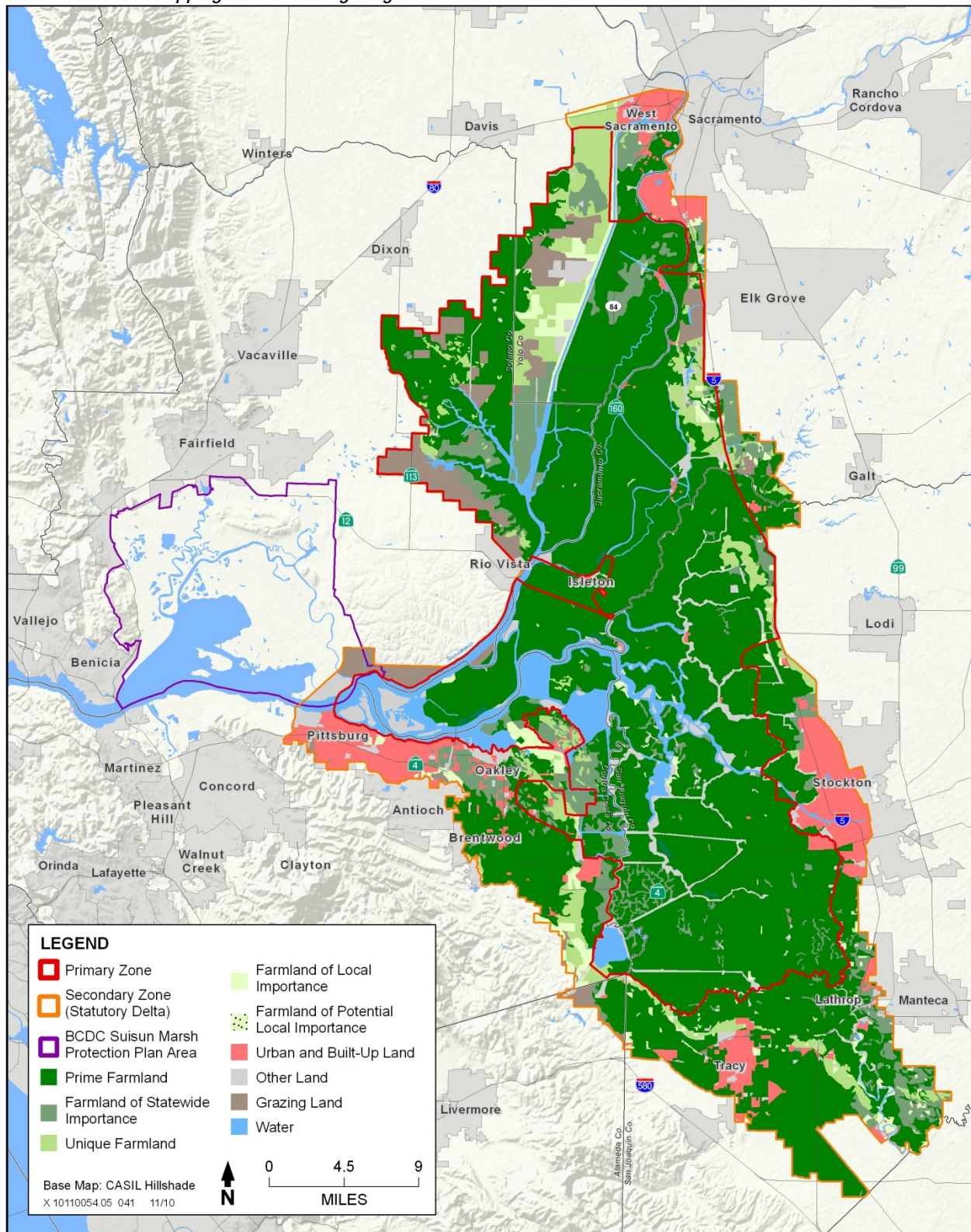
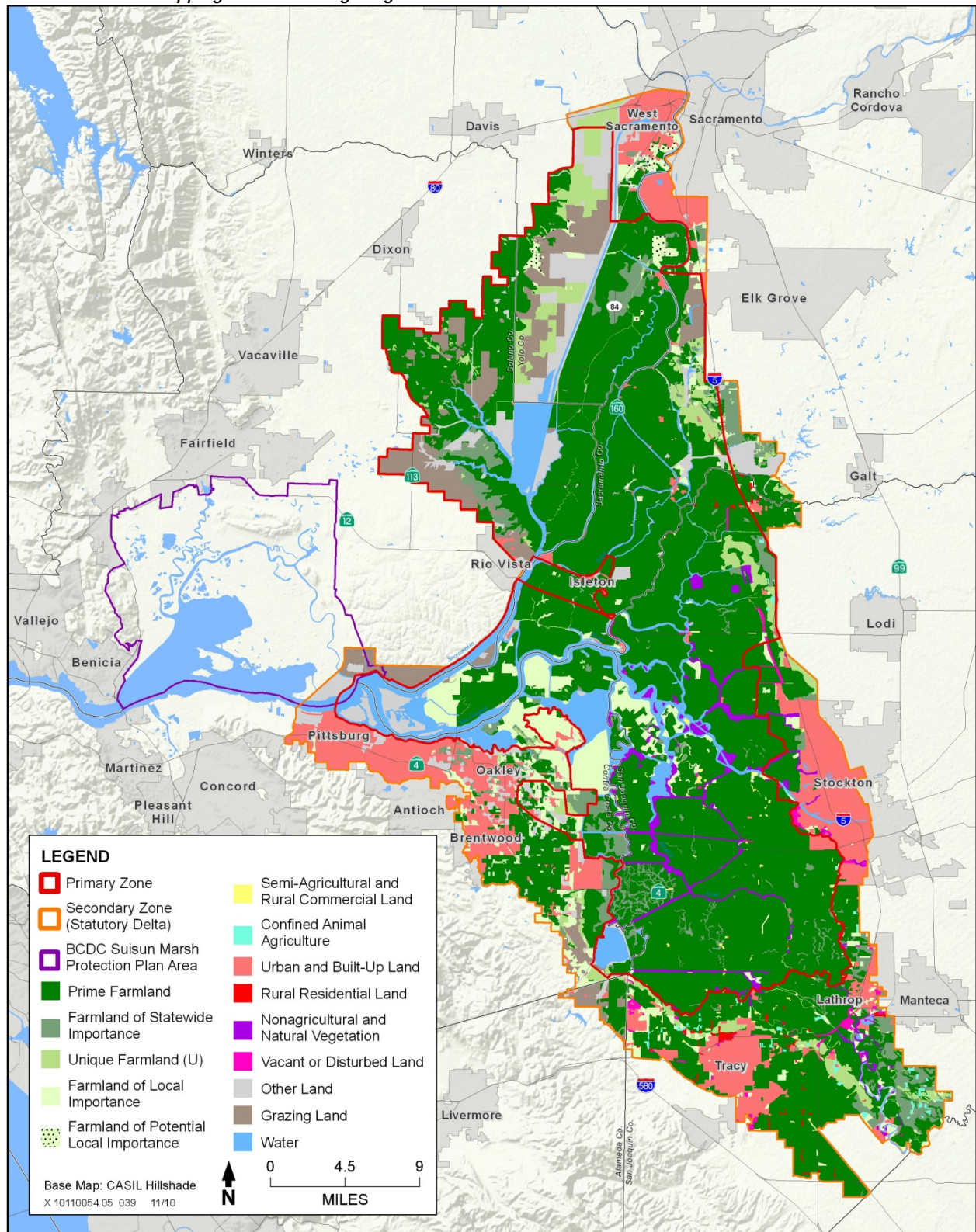


Figure 2
Urban and Agricultural Land Use in and near the Delta and Suisun Marsh in 2008
Source: Farmland Mapping and Monitoring Program 2008



Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-3:

Continued pressure exists to develop lands within the Delta.

During the past 40 years, growth of Central Valley cities such as Sacramento, Stockton, Oakley, Brentwood, Tracy, and Lathrop has changed land uses within the Delta.

The Delta Protection Commission's Land Use and Resource Management Plan (2010) states:

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the secondary zone to impact the Primary Zone.

The Delta Vision Strategic Plan (2008) also discussed the potential pressures and impact of future population growth on development:

One estimate suggests that the five counties that include the Delta could more than double in population by 2050... Without appropriate safeguards, growth of this magnitude would have enormous impacts on the Delta... It is critically important that better land use decisions be made in the future and that the protection of the Delta primary zone and key locations in the secondary zone be enhanced.

Based on U.S. Census block group-level data for 2000, the population on Delta Islands and tracts was approximately 26,000 in 2000, and is expected to grow to about 67,000 in 2030. Estimates reported by DWR as prepared by staff for the Central Valley Flood Protection Board indicate that as many as 130,000 new homes could be constructed within the legal Delta in the next decade (DWR, 2007). Most of the future population growth in the Delta is expected to occur along the periphery of the Delta. Currently, the majority of future growth within the unincorporated areas of the legal Delta is located within spheres of influence of incorporated cities with San Joaquin and Contra Costa counties with smaller areas located near Freeport in Sacramento County and Rio Vista in Solano County.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

California Department of Conservation. Farmland Mapping and Monitoring Program GIS data, 1984-2008.

California Department of Water Resources. 2007. *Status and Trends of Delta-Suisun Services Supplemental CD*. May.

Delta Protection Commission, 2010. *Land Use and Resource Management Plan*. February 25.

Sacramento County Local Area Formation Commission website, accessed January 20, 2011.

San Joaquin County Local Area Formation Commission website, accessed January 20, 2011.

Solano County Local Area Formation Commission website, accessed January 20, 2011.

Yolo County Local Area Formation Commission website, accessed January 20, 2011.

Contra Costa County Local Area Formation Commission website, accessed January 20, 2011.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-4:

Cities and counties are primarily responsible for land use decisions affecting the Delta.

Local general plans and development regulations (such as zoning codes) are the primary mechanisms for implementing land use policy. While state and federal laws and regulations may influence local land use policies, zoning codes, and development permit decisions, only cities and counties adopt general plans and zoning ordinances regulating specific uses of land.

Title 7 of the California Government Code provides the statutory authority and sets forth legal requirements for cities and counties to plan and regulate land use. General plans, community plans, and other related plans work together to guide the type, location, and intensity of development.

Land use is regulated in the Delta primarily through county general plan policies. Government Code section 65300 requires cities and counties to prepare and adopt a “comprehensive, long-range general plan”. To successfully guide long-range development, a general plan requires a complex set of analyses, comprehensive public outreach and input, and public policy for a vast range of topic areas. State law also specifies the content of general plans. Current law requires seven mandated elements: land use, circulation, housing, conservation, open space, noise, and safety. According to the guidelines of the Governor’s Office of Planning and Research guidelines regarding general plans, topics from different elements may be combined, but all must be addressed within the general plan. Cities and counties may include other topics in their general plans as optional elements, and many do so. Examples include agriculture, water resources, local economy or economic development, infrastructure and public services, and, more recently, climate change.

Delta counties’ general plans may require development activities to be consistent with Delta Protection Commission’s policies. For example, Solano County’s general plan requires that public and private management and development activities within the Primary Zone of the Delta be consistent with the goals, policies, and provisions of the Delta Protection Commission’s Land Use and Resource Management Plan as adopted.

Article 8 of the Government Code allows cities and counties to prepare specific plans, which are detailed sub-area plans intended to implement a local general plan. Specific plans must be consistent with the local general plan and may address any other subjects that are necessary or desirable for implementation of the general plan. In addition, public works projects, subdivision maps, and zoning codes affecting properties within a specific plan area must be consistent with that plan.

Zoning ordinances specify the details of permitted uses, lot sizes, residential densities and non-residential intensities of land use, the standards and conditions under which development may be permitted, the process by which development proposals will be considered and approved, and other details of development. Zoning ordinances must be consistent with general plans and specific plans.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

California Government Code section 65300.

California Department of Water Resources. 2007. *Status and Trends of Delta-Suisun Services*. May.

Delta Protection Commission, 2010. *Land Use and Resource Management Plan*. February 25.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-4:

Local land use decisions upstream of the Delta and Suisun Marsh impact the Delta.

Local land use decisions in the Delta watershed can affect water quality and water flow patterns in the Delta through changes in water diversion patterns (e.g., when agricultural lands are converted to urban uses water diversion patterns shift from the spring and summer months to throughout the year), runoff water quality (e.g., runoff from agricultural lands may include more sediment and chemicals used from agricultural practices and urban uses may include more petroleum products and household chemicals), and runoff water quantity (e.g., rainfall that was frequently absorbed on agricultural lands may become high volume runoff from pavement in urban areas).

The Stage I Final Assessment of the CALFED Water Quality Program published in 2007 stated:

Land- and anthropogenic-derived materials (organic carbon, nutrients, and pathogens) do not come from the estuary, but from the Delta watershed, in-Delta land, and biological processes within Delta waters. The Sacramento, San Joaquin, and smaller eastside tributaries carry loads of natural organic matter that vary by composition by source and by upstream hydrologic conditions. These loads enter the Delta and are mixed as water flows through Delta channels, where they can be changed by activities/processes on Delta lands and wetlands and by biological changes within the water column.

In Water Code section 85003, the legislature described some of the impacts on the natural Delta from past land use decisions and altered water flow patterns upstream of the Delta.

As agriculture and population expanded in the Delta and throughout California, increasing numbers of levees, dams, diversions, and water conveyance facilities were constructed in the Delta and upstream. These facilities altered the flow of fresh water and natural flooding and inundation patterns from the Sacramento and San Joaquin rivers and other natural waterways through the Delta and into Suisun and Grizzly bays. This change in water flow, in turn, increased the frequency of salinity intrusion in the Delta, affecting agriculture and the Delta environment as a whole.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

CALFED Bay-Delta Program. 2007. *CALFED Water Quality Program Stage 1 Final Assessment*. Final Draft. October.

California Water Code section 85003.

California Department of Water Resources. 2007. *Status and Trends of Delta-Suisun Services*. May.

Delta Protection Commission, 2010. *Land Use and Resource Management Plan*. February 25.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-4:

The complex system of Delta governance complicates coordinated and integrated planning efforts in the Delta.

Executive Order S-17-06 and the Delta Vision Strategic Plan (2008) described the conclusions of the Little Hoover Commission:

In 2005, the Little Hoover Commission concluded that the CALFED process, launched by the Bay-Delta Accords of 1994 and formalized by the CALFED Record of Decision in 2000, had failed to improve Delta sustainability. CALFED was criticized for its structure in which “no one level of government is fully in charge, or capable of responding in an orderly and effective way to address and mitigate the range of threats to the Delta.”

This is evident in part by the complex system of federal, State, and local agencies which governs the Delta’s land use. The Delta Vision Strategic Plan (2008) found that “literally hundreds of federal, state, and local governmental entities share responsibility for the Delta and its resources, and no one entity is responsible for managing important state interests.”

Although the federal government does not directly regulate land uses in the sense of designating specific land use or zoning categories and development standards, various federal laws and regulations, and the federal agencies assigned to implement those law and regulations, do influence local land use decisions.

The primary State agencies that could influence land use decisions in the Delta include various departments of the California Environmental Protection Agency, the California Natural Resources Agency, the Central Valley Flood Protection Board, and the State Mining and Geology Board. In addition, the State Lands Commission has jurisdiction over lands connected to the State’s water bodies and coastlines and retains surface mineral rights over school lands.

The primary method by which land use is regulated in the Delta is through local governments and county general plan policies. However, in the Delta these plans do not integrate with each other at boundary lines or have a coordinated regional approach to the management of Delta resources. County general plans also may not fully address upcoming issues such as future infrastructure threats or ecosystem restoration needs that are called for by the Delta Protection Commission (DPC), Biological Opinions, and state agency plans with jurisdiction in the Delta.

In addition to a complex governance system, many plans and projects can affect the land forms and land uses in the Delta, including work on flood management policies affecting levees, flood ways and allowable land uses, patterns of land use allowed under the policies of the DPC and local governments, ecosystem restoration projects, habitat conservation plans, improved water conveyance, and other infrastructure investments.

Also, current county general plan policies coupled with the existing land uses in these communities put possible land uses in competition with each other. For example, one county’s priority to

preserve agricultural uses above other land uses indicates that uses such as ecosystem restoration must only occur if it is not a threat to agricultural productivity. The counties tend to focus their planning inward, looking within their boundaries to determine the best uses for their lands and determine how those uses further the goals set forth by each individual county. Although the counties' general plans do not wholly ignore the concept of region-wide planning in the Delta, most of the jurisdictions do not make regional planning the main focus of their land use designations or policy direction.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October. pp.14, 121.

Delta Protection Commission, 2010. *Land Use and Resource Management Plan*. February 25.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

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Anecdotal evidence	Personal observations and beliefs	Limited to none	Fast	Available from individuals and groups
¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-4:

Comprehensive regional planning based on coordinated local efforts can best achieve the legislative objectives of the Delta Plan.

The primary method by which land use is regulated in the Delta is through local governments and county general plan policies. However, in the Delta these plans do not integrate with each other at boundary lines or have a coordinated regional approach to the management of Delta resources. Although the counties' general plans do not wholly ignore the concept of region-wide planning in the Delta, most of the jurisdictions do not make regional planning the main focus of their land use designations or policy direction.

County general plans also may not fully address upcoming issues such as future infrastructure threats or ecosystem restoration needs that are called for by the Delta Protection Commission (DPC), Biological Opinions, and state agency plans with jurisdiction in the Delta. Also, many plans and projects can affect the land forms and land uses in the Delta, including work on flood management policies affecting levees, flood ways and allowable land uses, patterns of land use allowed under the policies of the DPC and local governments, ecosystem restoration projects, habitat conservation plans, improved water conveyance, and other infrastructure investments. There is no guarantee or that these projects are fully integrated or coordinated.

The objectives of the Delta Plan are inherent in achieving the coequal goals. The Delta Vision Blue Ribbon Task Force identified the existing complex governance system in the Delta and its limits to achieving the coequal goals. The Task Force studied and recommended a governance structure that could best achieve these objectives in their Strategic Plan (2008):

Attaining the co-equal goals is impossible without a new system of governance in the Delta. The new governance system must be capable of making difficult decisions and implementing effective policies...

The Task Force's Vision called for a more effective governance structure that would "...ensure integrated action to implement this vision." In this Strategic Plan, the form of that governance is detailed. The challenges of creating this new structure begin with a lack of unanimity over the proper goals to pursue and are compounded by climate change and sea level rise, as well as threats to the Delta and California's water supply system from earthquakes, floods, levee failures, and invasive species.

The Task Force recommended comprehensive regional land use planning implemented through reliance on local government in its local land use planning procedures and enforcement:

...using existing agencies and authorities to the greatest possible extent...to ensure consistency and coordination among them through the creation of a single governing plan...and a...Council to oversee and enforce its implementation... Approving a [Delta] Plan governing the Delta thereby ensures consistency among existing state, federal, regional,

and local agencies and provides the flexibility needed to meet the Delta's management challenges. Local governments and other state and federal agencies will continue planning, decision-making, and operations—consistent with the [Delta] Plan.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique cultural values of the California Delta as an evolving place.

Additional Information:

Schwarzenegger, Arnold. 2006. *Executive Order S-17-06* of September 28.

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October. p.110-113, 121-131.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

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If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-4:

Delta waterways provide significant recreational benefits to all Californians.

The California legislature recognized the significant recreational opportunities offered by the Delta to the benefit of all Californians. The legislature declared these benefits, and related needs with increased attention and use of these resources, in Public Resources Code sections:

29712 (a) The delta's waterways and marinas offer recreational opportunities of statewide and local significance and are a source of economic benefit to the region, and, due to increased demand and usage, there are public safety problems associated with that usage requiring increased coordination by all levels of government.

32301 (e) The Delta and Suisun Marsh provide numerous opportunities for recreation, such as boating, kayaking, fishing, hiking, birding, and hunting. Navigable waterways in the Delta are available for public access and currently make up the majority of recreational opportunities. There is a need for land-based recreational access points including parks, picnic areas, and campgrounds.

Overall visitation was estimated at 12 million visitor days of use annually from the mid 1970's to 1990, more than three times the recent average 3.6 million that annually visit Yosemite National Park.

The Delta Protection Commission's Land Use and Resource Management Plan (2010) identifies concerns about funding availability for maintenance of recreational facilities and for the provision of new facilities.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique recreational values of the California Delta as an evolving place.

Additional Information:

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October.

Delta Protection Commission. 1994. *Delta Protection Commission Recreation and Access Study*. Prepared by Brady and Associates, Inc. p. 27-28.

Delta Protection Commission. 2010. *Land Use and Resource Management Plan*. February 25. p. 21.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-4:

Boating within the Delta provides a significant regional economic benefit.

The California legislature recognized the significant recreational opportunities offered by the Delta to the benefit of all Californians, recognizing boating specifically in Public Resources Code sections:

29712 (b) Recreational boating within the delta is of statewide and local significance and is a source of economic benefit to the region, and to the extent of any conflict or inconsistency between this division and any provisions of the Harbors and Navigation Code, regarding regulating the operation or use of boating in the delta, the provisions of the Harbors and Navigation Code shall prevail.

32301 (e) The Delta and Suisun Marsh provide numerous opportunities for recreation, such as boating, kayaking, fishing, hiking, birding, and hunting. Navigable waterways in the Delta are available for public access and currently make up the majority of recreational opportunities. There is a need for land-based recreational access points including parks, picnic areas, and campgrounds.

The Delta Protection Commission's Land Use and Resource Management Plan (2010) stated:

Navigable waterways in the Delta-Suisun area are publicly accessible and currently constitute the majority of the recreational opportunities within the Delta. Boating use totals more than 6.4 million visitor days annually, composed of 2.13 million annual boat trips in the larger Delta-Suisun area. The Aquatic Recreation Component of the Delta Recreation Strategy Plan prepared by the Delta Protection Commission forecasts demand for boating recreation through 2020 and identifies a deficit of facilities.

The California Department of Parks and Recreation (1997) found that over 20 percent of all boating trips in California occurred in the Delta. These Delta visitors provide a corresponding economic benefit to the region. Isolated boating related annual expenditures inside the Delta were estimated in 1998 at approximately \$250 million. (Goldman et. al 1998)

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique recreational values of the California Delta as an evolving place.

Additional Information:

California Department of Parks and Recreation. 1997. *Sacramento-San Joaquin Delta Recreation Survey*. August. p. 134.

California Department of Water Resources. 2007. *Status and Trends of Delta-Suisun Services*. May.

Delta Protection Commission. 2010. *Land Use and Resource Management Plan*. February 25. p. 21.

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October.

Not Reviewed or Approved by Delta Stewardship Council
Administrative Draft: Subject to Revision

Goldman, George, Bruce McWilliams, Vijay Pradhan, Cheryl Brown. 1998. *The Economic Impact of Recreational Boating and Fishing in the Delta*. Department of Agricultural and Resource Economics. University of California at Berkeley. November. p. 12.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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Science expert opinion	Opinion and broadly held understanding	Through reputation only	Fast	Available from individuals and groups
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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-4:

The Delta provides opportunities for a variety of water-based recreation.

The California legislature recognized the significant water-based recreational opportunities offered by the Delta in Public Resources Code sections:

29712 (a) The delta's waterways and marinas offer recreational opportunities of statewide and local significance and are a source of economic benefit to the region, and, due to increased demand and usage, there are public safety problems associated with that usage requiring increased coordination by all levels of government.

32301 (e) The Delta and Suisun Marsh provide numerous opportunities for recreation, such as boating, kayaking, fishing, hiking, birding, and hunting. Navigable waterways in the Delta are available for public access and currently make up the majority of recreational opportunities. There is a need for land-based recreational access points including parks, picnic areas, and campgrounds.

The Delta Protection Commission's Land Use and Resource Management Plan describes the needs for land-based recreation access points and funding to build and maintain them:

The majority of the land within the Delta is privately owned, which reduces the availability of land-based recreation... Concerns regarding existing and future recreational activities within the Delta include compatibility with agricultural operations and other private property uses, funding availability for the long-term maintenance and supervision of existing recreational facilities and for the development of new recreational facilities, ...overuse of existing facilities and popular waterways, ...and increased demands on law enforcement and other emergency response providers.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique recreational values of the California Delta as an evolving place.

Additional Information:

Delta Protection Commission. 1994. *Delta Protection Commission Recreation and Access Study*. Prepared by Brady and Associates, Inc. p. 27-28.

Delta Protection Commission. 2010. *Land Use and Resource Management Plan*. February 25. p. 21.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.¹²

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-5:

Delta waterways provide aquatic habitat and area a popular source of recreation.

The California legislature recognized the significant water-based recreational opportunities offered by the Delta in Public Resources Code sections:

29712 (a) The delta's waterways and marinas offer recreational opportunities of statewide and local significance and are a source of economic benefit to the region, and, due to increased demand and usage, there are public safety problems associated with that usage requiring increased coordination by all levels of government.

32301 (e) The Delta and Suisun Marsh provide numerous opportunities for recreation, such as boating, kayaking, fishing, hiking, birding, and hunting. Navigable waterways in the Delta are available for public access and currently make up the majority of recreational opportunities.

The Delta Protection Commission's Land Use and Resource Management Plan (2010) describes the interdependence of habitat and outdoor recreation in the Delta

The Delta lands currently have access to the 1,000 miles of rivers and sloughs lacing the region. These waterways provide habitat for many aquatic species and the uplands provide year-round and seasonal habitat for amphibians, reptiles, mammals, and birds, including several rare and endangered species. The area is extremely popular for many types of recreation including fishing, boating, hunting, wildlife viewing, water-skiing, swimming, hiking, and biking.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique recreational values of the California Delta as an evolving place.

Additional Information:

Delta Protection Commission. 1994. *Delta Protection Commission Recreation and Access Study*. Prepared by Brady and Associates, Inc. p. 27-28.

Delta Protection Commission. 2010. *Land Use and Resource Management Plan*. February 25. p. 3, 21.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. *Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems*. Marine and Freshwater Research 61: 821-828.

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-5:

The Delta's cultural heritage is linked to recreational opportunities offered by its numerous waterways, agriculture, and biological diversity.

The Delta Protection Commission's Land Use and Resource Management Plan (2010) describes the interdependence of habitat and outdoor recreation in the Delta:

The Delta lands currently have access to the 1,000 miles of rivers and sloughs lacing the region. These waterways provide habitat for many aquatic species and the uplands provide year-round and seasonal habitat for amphibians, reptiles, mammals, and birds, including several rare and endangered species. The area is extremely popular for many types of recreation including fishing, boating, hunting, wildlife viewing, water-skiing, swimming, hiking, and biking.

The Delta Protection Commission further emphasizes this linkage through its Land Use Policy P-1:

The rich cultural heritage, strong agricultural/economic base, unique recreational resources, and biological diversity of the Delta shall be preserved and recognized in public/private facilities, such as museums, recreational trails, community parks, farm stands, community centers, and water access facilities within the Delta.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique recreational values of the California Delta as an evolving place.

Additional Information:

Delta Protection Commission. 2010. *Land Use and Resource Management Plan*. February 25. p. 3, 8, 21.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-5:

The Delta is an agricultural region of great value to the state and nation and the retention and continued cultivation and production of fertile peatlands and prime soils are of significant value.

Many times the California legislature has found the Delta to be a unique and significant place based on its distinctive natural resources and agricultural heritage (Public Resources Code section 32301):

(a) The Sacramento-San Joaquin Delta is a unique natural resource of local, state, and national significance... (d) The Delta contains more than 500,000 acres of agricultural land, with unique soils, and farmers who are creative and utilize innovative agriculture, such as carbon sequestration crops, subsidence reversal crops, wildlife-friendly crops, and crops direct for marketing to the large urban populations nearby....

The legislature noted the value of retaining the production of peat and prime soils, as well as agriculture's economic value to the state, in Public Resources Code section 29703:

(a) The delta is an agricultural region of great value to the state and nation and the retention and continued cultivation and production of fertile peatlands and prime soils are of significant value.

(b) The agricultural land of the Delta...adding greatly to the economy of the state...

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique agricultural values of the California Delta as an evolving place.

Additional Information:

Delta Vision Blue Ribbon Task Force, 2008. *Delta Vision Strategic Plan*. October.

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

CH2M HILL. 2010. *Delta as a Place: Agriculture White Paper*. Prepared for consideration by the Delta Stewardship Council. December 6.

California Department of Water Resources (DWR). 2007. *The Value of the Agricultural Output of the California Delta*. Revised Draft Paper by Jim Rich, DWR, Division of Planning and Local Assistance. September 21, 2006; Revised February 22.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-5:

Agriculture is the principal land use in the Delta but has declined from 80 percent of the Delta's total land area in 1984 to 74 percent in 2008.

The Delta Protection Commission's Land Use and Resource Management Plan states:

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the secondary zone to impact the Primary Zone.

An illustration of how land use patterns have changed over time can be seen in Figures 1 and 2. Between 1984 and 2008, approximately 60,237 acres of farmland (classified as prime, statewide importance, local importance, potential local importance, and unique) has been lost to urban development in the legal Delta. Currently, about 75 percent of the Delta's total land area is Prime Farmland, the most productive category of farmland. However, the division of agricultural lands into smaller parcel sizes adversely affects the viability of agriculture. All Delta counties have experienced significant parceling of agricultural lands and increasing rural residential development, replacing agricultural uses and encroaching into agricultural areas.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique agricultural values of the California Delta as an evolving place.

Additional Information:

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

CH2M HILL. 2010. *Delta as a Place: Agriculture White Paper*. Prepared for consideration by the Delta Stewardship Council. December 6.

California Department of Conservation. Farmland Mapping and Monitoring Program GIS data, 1984-2008.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

Source: Federal Mapping and Monitoring Program, 1984

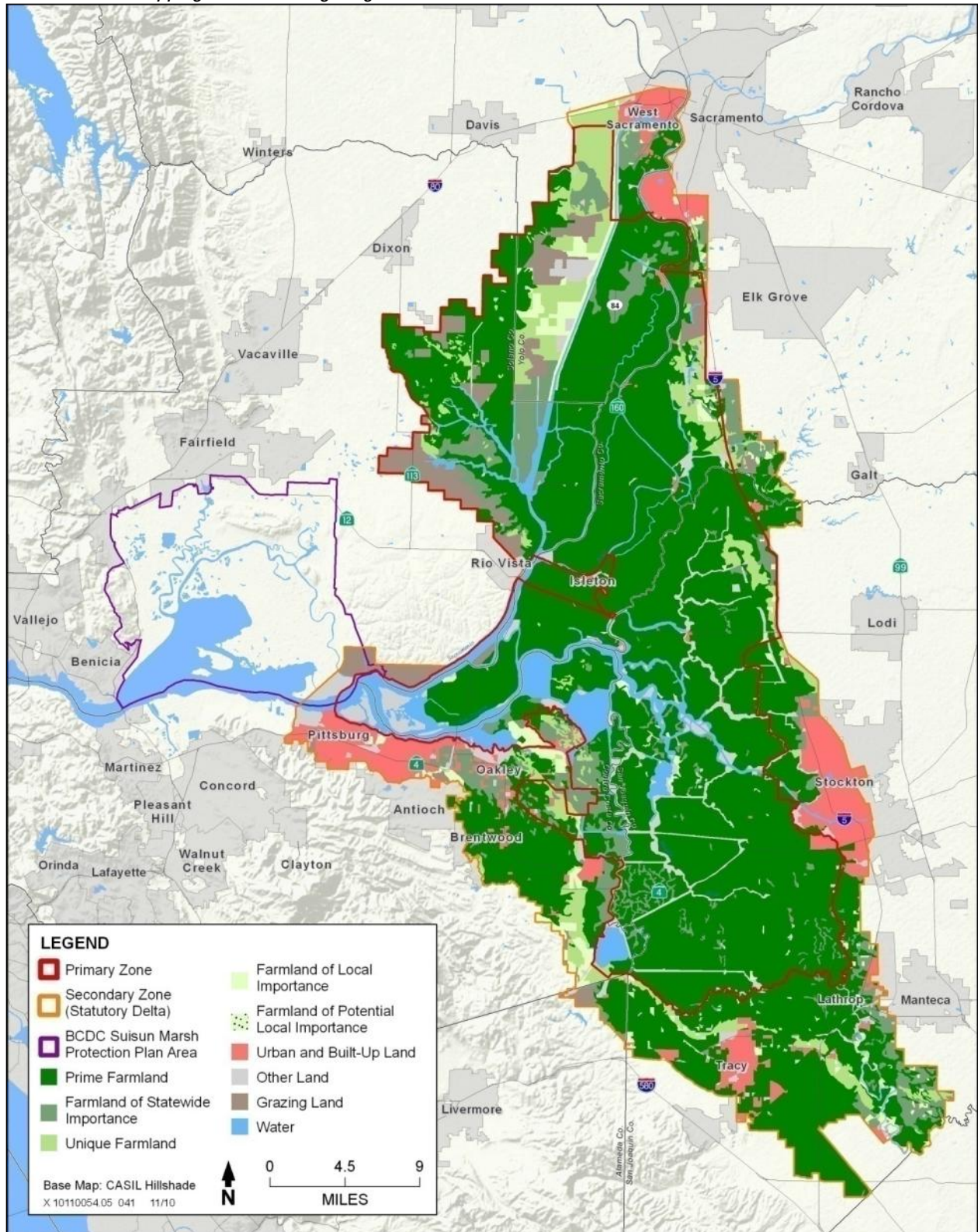
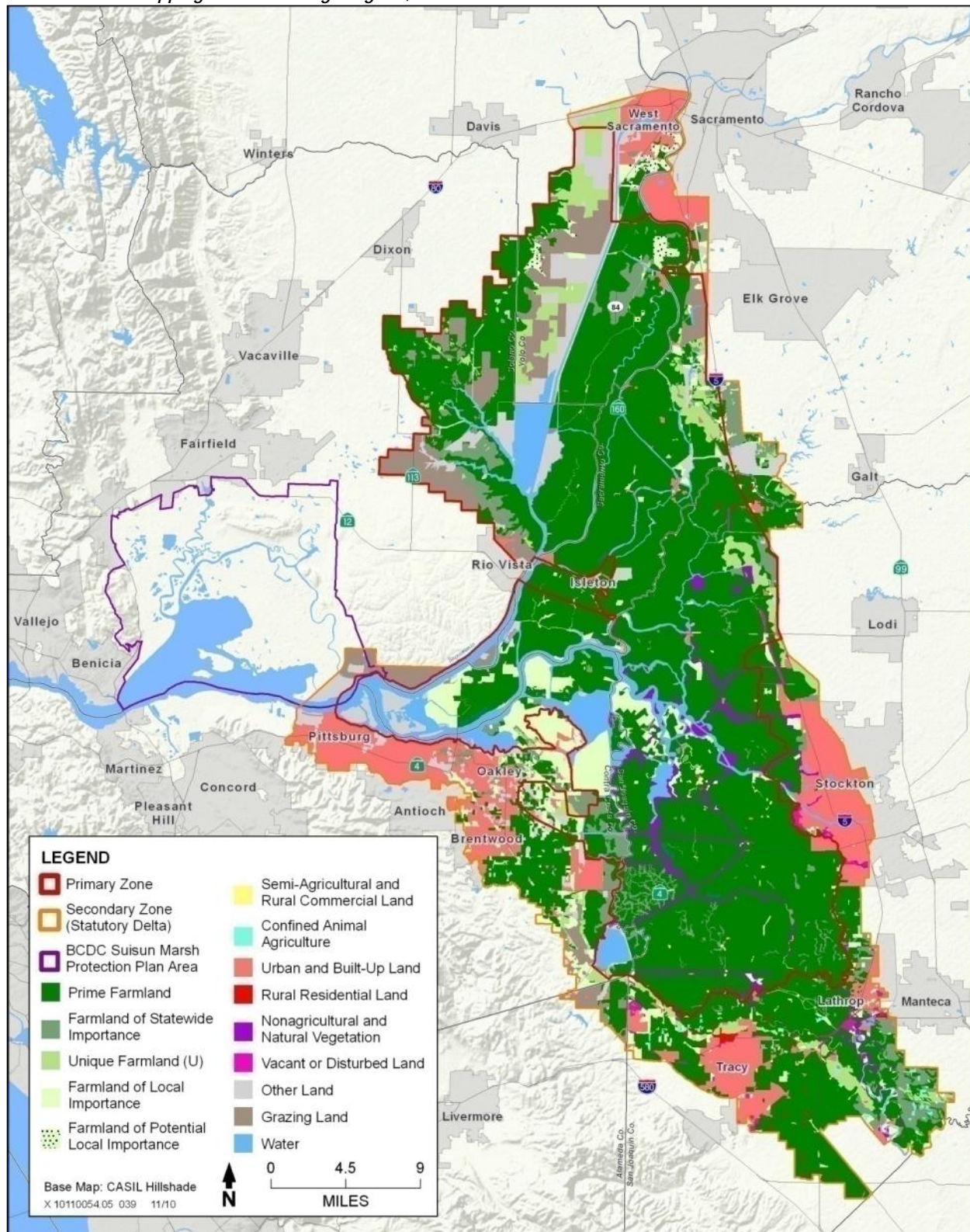


Figure 2
Delta Farmland in 2008
Source: Federal Mapping and Monitoring Program, 2008



BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-5:

Levee construction and conventional agricultural practices have resulted in subsidence of Delta islands.

Land subsidence on the interior of islands and tracts has created large areas below sea level. Today, some areas are as much as 25 feet below sea level. Recently the California Departments of Water Resources and Fish and Game (2008, p. 12) reported:

The last 100 years of land subsidence has made the Delta islands deeper and resulted in building levees higher. These levees are more susceptible now to failure during an earthquake than they were in 1906.

The Department of Water Resources described the causes and science of subsidence in their Status and Trends of Delta-Suisun Services (2007):

The rich organic peat soils in the Delta-Suisun built up over thousands of years as plants grew and died in the swampy environment. Because the land was waterlogged and anaerobic (devoid of oxygen), organic soils accumulated faster than they could decompose, forming large expanses of peat soil. With the construction of levees and drainage for agriculture, the peat soils were exposed to the atmosphere. Some soil has blown away with the wind and some has burned, but the major portion has simply decomposed [through] microbial oxidation, which consumes the peat soils. Most of the carbon loss is emitted as carbon dioxide gas to the atmosphere. About one-half of the peat soil that accumulated over 5,000 years has disappeared during the last 150 years.

Land subsidence in some areas continues at the rate of 0.5 to 1.5 inches of soil loss per year. The agencies forecasted that over the next 200 years, some areas of the central Delta, could subside by another 18 feet below existing land levels if current land use practices continue to deplete peat soils and increase stress on existing levees. Changes in agricultural management and crop types may help stabilize or increase Delta elevations.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique agricultural values of the California Delta as an evolving place.

Additional Information:

California Department of Water Resources and Department of Fish and Game, 2008. *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta*. Prepared pursuant to requirements of Assembly Bill 1200. January. p. 12.

California Department of Water Resources, 2007. *Status and Trends of Delta-Suisun Services*. May. pp. 4, 38-39.

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-5:

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth.

During the past 40 years, development within the Delta has occurred in unincorporated county areas (such as Discovery Bay), adjacent to historic cities (such as Brentwood and Oakley), and major Central Valley cities (such as Sacramento, Stockton, and Lathrop).

The Delta Protection Commission's Land Use and Resource Management Plan states:

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the secondary zone to impact the Primary Zone.

In 2000, the total population within the five Delta counties was approximately 3.3 million. The California Department of Finance estimates that the combined population of the Delta counties will grow from about 3.3 million in 2000 to about 7.7 million in 2050, an increase of more than 130 percent (DWR, 2007). Based on U.S. Census block group-level data, the population within the Secondary and Primary Zones in 2000 was approximately 501,100 and 79,700, respectively (U.S. Census Bureau, 2000). In addition, the population on Delta Islands and tracts was approximately 26,000 in 2000, and is expected to grow to about 67,000 in 2030. Although this is significant growth, most of the future population growth in the Delta will occur outside the islands and tracts (DWR, 2007). For the 8-year period between 2000 and 2008, the combined population within the five Delta counties was approximately 3.8 million.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique agricultural values of the California Delta as an evolving place.

Additional Information:

California Department of Finance. 2010. Population and Housing Estimates for Cities, Counties and the State, 2001-2010, with 2000 Benchmark. May.

California Department of Water Resources, 2007. *Status and Trends of Delta-Suisun Services Supplemental CD*. May.

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

U.S. Census Bureau, 2000.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-6:

Urbanization and loss of agricultural lands have occurred under local planning policies that are not consistent throughout the Delta.

During the past 40 years, development within the Delta has occurred in unincorporated county areas (such as Discovery Bay), adjacent to historic cities (such as Brentwood and Oakley), and major Central Valley cities (such as Sacramento, Stockton, and Lathrop).

The Delta Protection Commission's Land Use and Resource Management Plan states:

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the secondary zone to impact the Primary Zone.

Local governments are primarily responsible for general plan policies. However, in the Delta, as in other areas of the state, these plans and policies frequently are not integrated with each other at boundary lines or have detailed coordinated regional approaches to the management of Delta resources.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique agricultural values of the California Delta as an evolving place.

Additional Information:

California Department of Water Resources, 2007. *Status and Trends of Delta-Suisun Services*. May. p. 36-37.

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

CH2M HILL. 2010. *Delta as a Place: Agriculture White Paper*. Prepared for consideration by the Delta Stewardship Council. December 6.

CH2M HILL. 2010. *Delta as a Place: Land Use White Paper*. Prepared for consideration by the Delta Stewardship Council. November 8.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. *Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems*. Marine and Freshwater Research 61: 821-828.

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-6:

The acquisition of farmland and subsequent retirement of that land affects the economic base for farm support industries.

The Delta Protection Commission's Land Use and Resource Management Plan (2010) determined that:

In addition to numerous local, national and international factors affecting the profitability of farming in the Delta, the acquisition of farmed land and subsequent retirement of that land affects the economic base for farm support industries; the economic base for community businesses that rely on patronage from citizens working in farm or farm support industries; the tax and assessment base for special districts, counties, and the State; and the existing wildlife use patterns that have adapted to agricultural land use patterns.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique agricultural values of the California Delta as an evolving place.

Additional Information:

California Department of Water Resources, 2007. *Status and Trends of Delta-Suisun Services*. May.

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25. p. 7-8.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-6:

Agriculture supports open space and habitat for waterfowl.

The legislature addressed the value of agriculture to wildlife habitat in Public Resources Code section 29703:

(b) Agricultural lands in the Delta, while adding greatly to the economy of the state, also provide a significant value as open space and habitat for waterfowl using the Pacific Flyway, as well as other wildlife. Continued dedication and retention of Delta lands in agricultural production contributes to the preservation and enhancement of open space and habitat values.

Public Resources Code section 29710 also notes that:

Agricultural, recreational, and other uses of the Delta can best be protected by implementing projects that protect wildlife habitat before conflicts arise.

Certain synergies between agriculture and wildlife habitat provide valuable ecological services in the Delta. Several types of agriculture, including alfalfa, pasture, and rice provide especially valuable wildlife habitat. Irrigated pastures, row crops, and silage fields provide habitat for small mammals, such as western harvest mouse and California vole, ground-nesting birds, and burrowing animals; these species in turn attract predators such as Swainson's hawk, other raptors, and coyote. Giant garter snake, a state and federally listed species, uses agricultural wetlands (such as rice fields), and agricultural irrigation and drainage canals for foraging habitat and dispersal, in addition to its remaining natural habitats. Crop types that are not tilled or disturbed are preferable as wildlife habitat. Flood-irrigated crops such as rice can also support a range of wildlife. Rice is usually grown in areas that previously supported natural wetlands, and many wetland-associated wildlife species use rice fields, especially waterfowl and shorebirds. Waste grain also provides food for species such as ring-necked pheasant and greater sandhill crane.

The Delta Vision Strategic Plan (2008) recommends the following action as a way to establish new markets for innovative agricultural products and enterprises in the Delta:

Action 2.2.3(b): Creating federal, state, and local mitigation requirements and agricultural easement programs that support the transition of Delta growers to multifunctional forms of agriculture, particularly ones that help wildlife habitat and flood management.

This finding is developed in support of Water Code section 85020:

(b) Protect and enhance the unique agricultural values of the California Delta as an evolving place.

Additional Information:

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

CH2M HILL. 2010. *Delta as a Place: Agriculture White Paper*. Prepared for consideration by the Delta Stewardship Council. December 6.

Delta Vision Blue Ribbon Task Force. 2008. *Delta Vision Strategic Plan*. October. p. 63.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-6:

Risks to the Delta must be reduced to allow for its evolution, protection, and enhancement.

Several recent studies have addressed risks to the Delta from sea level rise, urbanization, water quality, invasive species, seismic activity, floods, and subsidence – among them, the *Delta Risk Management Strategy Phase 1 Report* (2009), the Natural Resources Agency's *California Climate Adaptation Strategy* (2009), and the *Delta Vision Strategic Plan* (2008).

The Department of Water Resources' *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta* (2008) stated:

The Delta is also at extraordinary risk of disaster. Much of the land is below sea level, protected by an aging system of public and private levees. Earthquakes, floods, and climate change pose threats to these levees and the state's supply of drinking and irrigation water. A mass failure of the levee system could have staggering effects upon California's economy, beginning with the 25 million urban water users and over 3 million acres of irrigated farmland that depend on water obtained from the Delta.

The legislature recognized that the Delta should be protected and enhanced in Public Resources Code section 29702:

(a)...The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

Delta Vision Blue Ribbon Task Force concluded that the risks to the Delta have grown to intolerable levels, and that for the Delta to continue to thrive as a place, risks to people, property, agriculture, industries, infrastructure, and natural habitats that make the Delta a unique place must be reduced. The Strategic Plan (2008) states:

Urban development is reducing wildlife habitat today and foreclosing future opportunities to improve the ecosystem—and Delta water conveyance. The threat of catastrophic failure from earthquake, flood, sea level rise, and land subsidence is painfully real and growing.

Risks to people, property, and state interests in the Delta have grown to intolerable levels. New levee policies, future-looking land use decisions, and far better emergency preparedness are needed immediately.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting appropriate land uses.

Additional Information:

California Department of Water Resources and Department of Fish and Game, 2008. *Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta*. Prepared pursuant to requirements of Assembly Bill 1200. January. p. 1.

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25.

California Department of Water Resources. 2009. *Delta Risk Management Strategy Phase 1 Report*. March.

Delta Vision Blue Ribbon Task Force. 2008. *Delta Vision Strategic Plan*. October. p. vi.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

Prioritized List of Sources of Science from Most to Least Scientific Credibility

Sources with more "scientific credibility" are at the top of the list.²²

Source	Content	Review Level	Timeliness	Availability
Peer-reviewed publications	New findings	Formal, independent external	Slow to medium	Broadly available
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¹ Sullivan et al., 2006; Ryder, D.S., M. Tomlinson, B. Gawne, and G.E. Likens. 2010. <i>Defining and using 'best available science': a policy conundrum for the management of aquatic ecosystems</i> . Marine and Freshwater Research 61: 821-828.				

BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-6:

Risk increases as the Delta's population grows.

The Delta Protection Commission's Land Use and Resource Management Plan (2010) states:

The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the secondary zone to impact the Primary Zone.

Development in the Delta may increase the number of people at risk and increase the value of property subject to flooding if the existing levees and other flood management facilities are not upgraded, replaced, or rehabilitated. Flood risks will remain for those who choose to reside in the Delta if the flood management and other infrastructure are not improved and maintained to reduce the risk.

The Delta Vision Strategic Plan notes:

Land use policies in the Delta must change in order to protect people, property, and state interests in the region over the coming decades. Development in deep floodplains and below sea level, which is hazardous for new residents and existing communities has not been adequately constrained.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting appropriate land uses.

Additional Information:

Delta Protection Commission, 2010. *Land Use and Resources Management Plan*. February 25. p. 7.

Delta Vision Blue Ribbon Task Force. 2008. *Delta Vision Strategic Plan*. October. p. 27.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

If the sources are of different levels of credibility, how would the sources be ranked based upon trade-offs associated with each? Could the following table be used?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-7:

Levees protecting urban and rural lands are, and need to remain, different.

The legislature found in Water Code section 9601:

(b) The Legislature recognizes that by their nature, levees, which are earthen embankments typically founded on fluvial deposits, cannot offer complete protection from flooding, but can decrease its frequency.

(c) The Legislature recognizes that the level of flood protection afforded rural and agricultural lands by the original flood control system would not be adequate to protect those lands if they are developed for urban uses, and that a dichotomous system of flood protection for urban and rural lands has developed through many years of practice.

(d) The Legislature further recognizes that levees built to reclaim and protect agricultural land may be inadequate to protect urban development unless those levees are significantly improved.

Responsibilities and liabilities for levee maintenance and flood damages in the Delta are often based on whether a levee is maintained for water supply purposes rather than the use of the land protected. The variance between the cost of maintenance and repair of a levee is not necessarily considered in context of the value of the lands protected by a levee.

The Delta Vision Strategic Plan (2008) concluded that levees protecting urban and rural lands should be considered differently:

The chief strategy is to match levee design to function throughout the Delta. Levees not only protect land uses on Delta islands, but they also protect the Delta from major saltwater intrusion and shape the flows of fresh water through the ecosystem...When setting levee policy, it is essential to look some decades in the future to protect levees that are critical to state interests. The overarching goal should be to reduce risk. But there are two sides to the risk equation—the quality of levees, and the value of the people, assets and resources they protect. The more intensive the land use in a particular place, or the more critical the levee is to the co-equal values, the stronger the levees should be. However, this principle should not be mistaken as encouragement for intensive urban development in order to finance levee costs within the Delta. Such development would place residents at unacceptable risks, even with new levees, and could also increase flood risks to neighboring islands or communities. Where levees are inadequate, intensive land uses such as housing should not occur. Land use decisions in the Delta are a matter of public safety.

This finding is developed in support of Water Code section 85305:

(a) *The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting appropriate land uses.*

Additional Information:

Delta Vision Blue Ribbon Task Force. 2008. *Delta Vision Strategic Plan*. October. p. 37-38, 110-111.

Science Assessment:

Analyses are pending but will address:

Do the referenced sources support the finding?

Are there other sources that would lead to a different finding?

If so, which sources do you recommend?

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-7:

Land use decisions must discourage development in floodprone areas.

The legislature found in Water Code section 9601:

(c) The Legislature recognizes that the level of flood protection afforded rural and agricultural lands by the original flood control system would not be adequate to protect those lands if they are developed for urban uses, and that a dichotomous system of flood protection for urban and rural lands has developed through many years of practice.

(e) Cities and counties rely upon federal flood plain information when approving developments, but the information available is often out of date and the flood risk may be greater than that indicated using available federal information.

(g) Linking land use decisions to flood risk and flood protection estimates comprises only one element of improving lives and property in the Central Valley. Federal, state, and local agencies may construct and operate flood protection facilities to reduce flood risks, but flood risks will nevertheless remain for those who choose to reside in Central Valley flood plains. Making those flood risks more apparent will help ensure that Californians make careful choices when deciding whether to build homes or live in Central Valley flood plains, and if so, whether to prepare for flooding or maintain flood insurance.

The Delta Vision Strategic Plan (2008) concluded that land use decisions should discourage development in floodprone areas:

Land use decisions in the Delta must be based on public safety. Even if new developments in flood-prone areas were to build their own levees, there would still be a considerable residual risk of flooding.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting appropriate land uses.

Additional Information:

Delta Vision Blue Ribbon Task Force. 2008. *Delta Vision Strategic Plan*. October. p. 110-111.

Science Assessment:

Analyses are pending but will address:

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BASIS OF DRAFT FINDINGS PRESENTED IN FIRST STAFF DRAFT DELTA PLAN

Draft Finding in February 14, 2011 First Staff Draft Delta Plan, Chapter 9, p. 9-7:

Appropriate land management can eliminate subsidence and reduce risks.

There are land management options which can eliminate subsidence, thereby reducing risks to the Delta. Two land management options for the Delta include Carbon Capture Wetland Farms and Low Carbon Agriculture, each of which could reduce soil loss and green house gas (GHG) emissions, reduce risks associated with land subsidence, and provide other environmental benefits to the Delta ecosystem. These options are discussed in detail the report “Greenhouse Gas Reduction and Environmental Benefits in the Sacramento-San Joaquin Delta: Advancing Carbon Capture Wetland Farms and Exploring Potential for Low Carbon Agriculture” (Nature Conservancy, et al. 2010):

Carbon Capture Wetland Farms are newly constructed wetlands operated to maximize retention of atmospheric carbon. Ongoing research conducted in the Delta since 1997 has demonstrated that native tule wetlands can capture carbon at very high rates and, in doing so, these wetlands accrete soil that significantly reverses subsidence.

There is also growing evidence that changes in Delta agricultural practices might allow for reduced greenhouse gas emissions and rates of ongoing subsidence. Such changes in farming practices, referred to here as Low Carbon Agriculture, might include increasing groundwater levels during the growing and fallow seasons, reducing tillage frequency and depth, tailoring fertilizer applications and associated improved soil nutrient management including increasing retention of crop residue, converting to rice production, and winter flooding.

This finding is developed in support of Water Code section 85305:

(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting appropriate land uses.

Additional Information:

Nature Conservancy et al, 2010. *Greenhouse Gas Reduction and Environmental Benefits in the Sacramento-San Joaquin Delta: Advancing Carbon Capture Wetland Farms and Exploring Potential for Low Carbon Agriculture*. December.

Science Assessment:

Analyses are pending but will address:

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